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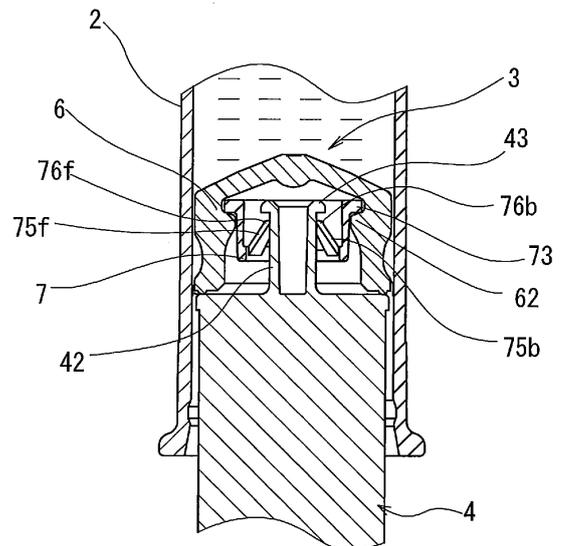
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(54) **PREFILLED SYRINGE**

(57) A gasket (3) of a prefilled syringe (1) is composed of a gasket body (6) and a plunger-mounting member (7). The gasket body (6) has a plunger-mounting member removal prevention rib (62) formed on an inner surface thereof. The plunger-mounting member (7) has an outer projected part (73) which engages the plunger-mounting member removal prevention rib (62) of the gasket body (6), a plurality of elastically deformable inner projected parts (75) which are extended obliquely from an inner portion of a proximal side of the plunger-mounting member (7) toward a central and distal end thereof, and plunger removal prevention locking parts (76) formed at free ends of the inner projected parts (75) respectively. The plunger (4) has a distal end part (42) capable of entering the plunger-mounting member (7) and an outer projection part (43) which engages the plunger removal prevention locking parts (76) of the plunger-mounting member (7).

Fig.16



Description

TECHNICAL FIELD

[0001] The present invention relates to a prefilled syringe in which a medicinal solution is filled in advance.

BACKGROUND ART

[0002] The prefilled syringe is classified into a type in which a plunger is not mounted on a gasket and mounted thereon when the prefilled syringe is used and a type in which the plunger is mounted on the gasket in advance. The prefilled syringe of the type in which the plunger is mounted on the gasket in advance is produced as follows: after the gasket is inserted into the outer cylinder by using a method so-called vacuum capping in which the gasket is disposed at the opening of the outer cylinder under a pressure-decreased atmosphere (under a vacuum atmosphere) in the state in which a medical agent is filled inside the outer cylinder whose opening disposed at its distal end is sealed, the plunger is mounted on the gasket at a normal pressure. In a state in which the plunger has been mounted on the gasket, it is difficult to dispose the gasket at the opening of the outer cylinder. Further it is necessary to additionally take the space in which the pressure is decreased in correspondence to the size of the plunger. Thus a vacuum capping work is performed without mounting the plunger on the gasket. Therefore the prefilled syringe of this type necessitates a plunger-mounting work to be performed subsequently. In the prefilled syringe of the type in which the plunger is not mounted on the gasket, a user performs an operation of mounting the plunger on the gasket when the user uses the prefilled syringe.

When the plunger is mounted on the gasket by press fit, there is a case in which a pressure generated by the press fit causes the medicinal solution to leak from the gasket or a nozzle of the outer cylinder. Therefore a prefilled syringe in which the gasket and the plunger are coupled to each other by screwing between a female screw formed on the gasket and a male screw formed on the plunger is frequently used.

There are many cases in which the prefilled syringe is used by mounting it on a syringe pump. The prefilled syringe is set on the syringe pump by mounting a flange disposed at the proximal end portion of the outer cylinder on a holder of the syringe pump and mounting a disk part disposed at the proximal end of the plunger on a fixing groove of a slider of the syringe pump. Some types of syringe pumps have a longitudinal slit for engaging a longitudinal rib with the slider. In such a type of the syringe pump, to fit the rib of the plunger in the longitudinal slit of the slider, it is necessary to make a fine adjustment by rotating the plunger to fit a rib of the plunger in the longitudinal slit of the slider. In the above-described type in which the plunger is mounted on the gasket by using screws, there is a case in which the engagement there-

between is loosened by the plunger-rotating operation.

[0003] The prefilled syringe proposed as disclosed in a patent document 1 (EP1849490, International Publication WO2006/087762) has the gasket 3 which slidably obstructs the inside of the barrel 2 where the lure taper part 5 is formed and has the hollow part 10 at the inner circumferential side thereof and the plunger rod 4. The plunger rod 4 is coupled to the gasket 3 through the anchor part 11. The anchor part 11 is formed projectingly from the pedestal part 18 composed of the tapered surface inclined at the angle of 5 to 45 degrees with respect to the surface of the plunger rod 4 orthogonal to the axial direction thereof and has the distal end contact part 22 which contacts the back side of the distal end of the gasket 3 and the contact member 12 which is freely fitted on the outer circumferential of the gasket 3 and contacts the inner circumferential wall thereof. The pedestal part 18 has the concave curved surface 20 between the distal-end contact part 22 and the tapered surface. The contact member 12 has the convex curved surface 28a at the portion opposed to the concave curved surface 20. The barrel 2 has the locking cylinder 6 having the spiral line 7 formed on the inner surface thereof.

In the prefilled syringe proposed as disclosed in a patent document 2 (Japanese Patent Application Laid-Open No. 2008-307237), the medicinal solution is filled therein and the gasket is inserted into the outer cylinder by the capping work. The prefilled syringe includes the coupler which screws on the proximal end of the gasket, the bottom rod coupled to the coupler at its proximal end, the stopper formed on the coupler, and the engaging part, formed on the bottom rod, which engages the stopper owing to the rotation of the bottom rod in the screwing direction. When the stopper contacts the engaging part in the direction opposite to the screwing direction, the stopper elastically deforms and does not engage the engaging part.

The present applicant proposed the syringe as disclosed in a patent document 3 (Japanese Patent Application Laid-Open No. 2009-142508). The syringe 10 has the gasket 3, the outer cylinder 2, and the plunger 4. The plunger 4 has the spiral rib 44 formed on the outer surface of the head part 42. The gasket 3 has the spiral screwing part 33 which screws on the spiral rib 44, the annular rib 34, for preventing the separation of the plunger from the gasket, which is located at a position in the vicinity of the spiral screwing part 33 and distal therefrom, and the accommodation part 32 for accommodating the portion where the spiral rib 44 of the head part 42 of the plunger is formed. The annular rib 34 has the rib-absent portion 35 for guiding the spiral rib 44 which has reached the annular rib owing to the progress of the screwing between the spiral rib 44 of the plunger and the spiral screwing part 33 of the gasket to the accommodation part.

[0004] In the prefilled syringes disclosed in the patent documents 2 and 3, it is necessary to perform a work of rotating the plunger to mount the plunger on the gasket. In the prefilled syringe disclosed in the patent document

1, it is not necessary to perform the work of rotating the plunger to mount the plunger on the gasket, but it is possible to mount the plunger on the gasket by pressing the distal end portion of the plunger into the gasket. But during the work of mounting the plunger on the gasket, there is a high possibility that the distal end portion of the plunger deforms the gasket, thus causing a medicinal solution to leak. In addition, there is a possibility that after the plunger is mounted on the gasket, the distal end portion of the plunger deforms the gasket when the plunger is pressed, thus causing the medicinal solution to leak.

PRIOR ART DOCUMENT

PATENT DOCUMENT

[0005]

Patent document 1: EP1849490 (International Publication WO2006/087762)

Patent document 2: Japanese Patent Application Laid-Open No. 2008-307237

Patent document 3: Japanese Patent Application Laid-Open No. 2009-142508

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0006] Therefore it is an object of the present invention to provide a prefilled syringe in which a plunger can be mounted on a gasket by pressing the plunger into the gasket and without applying a high pressure to the gasket, coupling between the plunger mounted on the gasket and the gasket can be prevented from loosening when the plunger is rotated, and the gasket is unlikely to deform, even though the plunger inclines.

MEANS FOR SOLVING THE PROBLEM

[0007] The prefilled syringe which achieves the above-described objects is as described below.

A prefilled syringe comprises a prefilled syringe body having an outer cylinder, a gasket slidably accommodated inside said outer cylinder, a sealing member which seals an opening formed at a distal end of said outer cylinder, and a medical agent accommodated inside a medical agent accommodation part formed inside said outer cylinder; and a plunger which is mounted on said gasket or mountable thereon; wherein said gasket is composed of a gasket body which is a tubular body whose distal end is closed and proximal end is open and which has an inner cavity extended from an opening formed at said proximal end thereof to said distal end thereof and a plunger-mounting member mounted on said gasket body; said gasket body has a plunger-mounting member removal prevention rib formed on an inner surface of said inner cavity; said plunger-mounting mem-

ber formed as a tubular body which has a hollow portion penetrating therethrough from a distal end thereof to a proximal end thereof and can be accommodated inside said inner cavity of said gasket body, comprising an outer projected part formed on an outer surface thereof and engaging a plunger-mounting member removal prevention rib of said gasket body, thus preventing said plunger-mounting member from separating from said gasket body; a plurality of elastically deformable inner projected parts which are extended obliquely from an inner portion of a proximal side of said plunger-mounting member toward a central and distal end thereof and have a free end respectively at a position which does not reach a center thereof; and plunger removal prevention locking parts formed at said free ends of said inner projected parts respectively; said plunger has a pressing part capable of pressing a proximal end portion of said gasket body in an operation of mounting said plunger on said gasket; a distal end part projected from said pressing part toward said distal end thereof and capable of entering said plunger-mounting member; and an outer projection part disposed on an outer surface of said distal end part and engaging said plunger removal prevention locking parts of said plunger-mounting member; and said plunger-mounting member is mounted on said gasket body in a state in which said plunger-mounting member removal prevention rib of said gasket body and said outer projected part of said plunger-mounting member have engaged each other; and when said plunger is mounted on said gasket, said distal end part of said plunger does not contact an inner surface of said gasket body.

EFFECT OF THE INVENTION

[0008] In the prefilled syringe of the present invention, by pressing the distal end portion of the plunger into the plunger-mounting member, it is possible to mount the plunger on the body of the prefilled syringe and it is unnecessary to rotate the plunger in the operation of mounting the plunger on the body of the prefilled syringe. In addition it is possible to securely restrain the gasket from being removed from the plunger mounted on the body of the prefilled syringe. Further even though the plunger mounted on the body of the prefilled syringe is rotated, the rotational force of the plunger is not transmitted to the gasket body, and thus the gasket is not deformed. Furthermore even though the plunger is inclined, the gasket is unlikely to be deformed and thus liquid leak is unlikely to occur.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Fig. 1 is a front view of a prefilled syringe of an embodiment of the present invention.
Fig. 2 is a sectional view taken along a line A-A of Fig. 1.

Fig. 3 is an enlarged front view of a gasket for use in the prefilled syringe of the present invention.

Fig. 4 is a sectional view taken along a line B-B of Fig. 3.

Fig. 5 is a front view of a gasket body for use in the gasket shown in Fig. 3. 5

Fig. 6 is a bottom view of the gasket body shown in Fig. 5.

Fig. 7 is a sectional view taken along a line C-C of Fig. 5. 10

Fig. 8 is a front view of a gasket-mounting member for use in the gasket shown in Fig. 3.

Fig. 9 is a sectional view taken along a line D-D of Fig. 8.

Fig. 10 is a plan view of the gasket-mounting member shown in Fig. 8. 15

Fig. 11 is a perspective view of the gasket-mounting member shown in Fig. 8 as viewed from a distal side thereof.

Fig. 12 is a perspective view of the gasket-mounting member shown in Fig. 8 as viewed from a proximal side thereof. 20

Fig. 13 is an enlarged front view of a plunger for use in the prefilled syringe of the present invention.

Fig. 14 is a plan view of the plunger shown in Fig. 13. 25

Fig. 15 is a perspective view of the plunger shown in Fig. 13.

Fig. 16 is an explanatory view for explaining an operation of mounting the plunger on the body of the prefilled syringe of the present invention. 30

Fig. 17 is a front view of an outer cylinder for use in the prefilled syringe of the present invention.

Fig. 18 is a sectional view of a sealing member (sealing cap) for use in the prefilled syringe of the present invention. 35

Fig. 19 is an enlarged front view of a gasket for use in a prefilled syringe of another embodiment of the present invention.

Fig. 20 is a sectional view taken along a line E-E of Fig. 19. 40

Fig. 21 is a vertical sectional view of a gasket body for use in the gasket shown in Fig. 19.

Fig. 22 is a front view of a gasket-mounting member for use in the gasket shown in Fig. 19.

Fig. 23 is a sectional view taken along a line F-F of Fig. 22. 45

Fig. 24 is a plan view of the gasket-mounting member shown in Fig. 22.

Fig. 25 is a perspective view of the gasket-mounting member shown in Fig. 22 as viewed from a distal side thereof. 50

Fig. 26 is a perspective view of the gasket-mounting member shown in Fig. 22 as viewed from a proximal side thereof.

Fig. 27 is an explanatory view for explaining an operation of mounting the plunger on the body of the prefilled syringe of the present invention in which the gasket shown in Fig. 19 is used. 55

Fig. 28 is an enlarged front view of a gasket for use in a prefilled syringe of another embodiment of the present invention.

Fig. 29 is a sectional view taken along a line G-G of Fig. 28.

Fig. 30 is a vertical sectional view of a gasket body for use in the gasket shown in Fig. 28.

Fig. 31 is a front view of a gasket-mounting member for use in the gasket shown in Fig. 28.

Fig. 32 is a sectional view taken along a line H-H of Fig. 31.

Fig. 33 is an explanatory view for explaining an operation of mounting the plunger on the body of the prefilled syringe of the present invention in which the gasket shown in Fig. 28 is used.

Fig. 34 is an enlarged front view of a gasket for use in a prefilled syringe of another embodiment of the present invention.

Fig. 35 is a sectional view taken along a line I-I of Fig. 34.

Fig. 36 is a vertical sectional view of a gasket body for use in the gasket shown in Fig. 34.

Fig. 37 is a front view of a gasket-mounting member for use in the gasket shown in Fig. 34.

Fig. 38 is a sectional view taken along a line J-J of Fig. 37.

Fig. 39 is an explanatory view for explaining an operation of mounting the plunger on the body of the prefilled syringe of the present invention in which the gasket shown in Fig. 34 is used.

Fig. 40 is an enlarged front view of a gasket for use in a prefilled syringe of another embodiment of the present invention.

Fig. 41 is a sectional view taken along a line K-K of Fig. 40. 35

Fig. 42 is a vertical sectional view of a gasket body for use in the gasket shown in Fig. 40.

Fig. 43 is a front view of a gasket-mounting member for use in the gasket shown in Fig. 40.

Fig. 44 is a sectional view taken along a line L-L of Fig. 43. 40

Fig. 45 is an explanatory view for explaining an operation of mounting the plunger on the body of the prefilled syringe of the present invention in which the gasket shown in Fig. 40 is used.

Fig. 46 is an enlarged front view of a plunger for use in a prefilled syringe of another embodiment of the present invention.

Fig. 47 is a perspective view of the plunger shown in Fig. 46.

Fig. 48 is an enlarged view of the neighborhood of a distal end portion of the plunger shown in Fig. 46.

Fig. 49 is an enlarged vertical sectional view of the neighborhood of the distal end portion of the plunger shown in Fig. 46. 50

Fig. 50 is an explanatory view for explaining an operation of mounting the plunger on the body of the prefilled syringe of the present invention in which the

plunger shown in Fig. 46 is used.

MODE FOR CARRYING OUT THE INVENTION

[0010] The prefilled syringe of the present invention is described below by using embodiments shown in the drawings.

A prefilled syringe 1 of the present invention has a prefilled syringe body 10 including an outer cylinder 2, a gasket 3 slidably accommodated inside the outer cylinder 2, a sealing member 5 which seals an opening formed at a distal end of the outer cylinder 2, and a medical agent 8 accommodated inside a medical agent accommodation part formed inside the outer cylinder 2; and a plunger 4 which is mounted on the gasket 3 or mountable thereon.

[0011] The gasket 3 is a tubular body whose a distal end is closed and a proximal end is open and composed of a gasket body 6 which has an inner cavity 60 extended from an opening formed at the proximal end thereof to the distal end thereof and a plunger-mounting member 7 mounted on the gasket body 6. The gasket body 6 has a plunger-mounting member removal prevention rib 62 formed on an inner surface of the inner cavity 60. The plunger-mounting member 7 is a tubular body having a hollow portion penetrating therethrough from a distal end thereof to a proximal end thereof and can be accommodated inside the inner cavity 60 of the gasket body 6. The plunger-mounting member 7 has an outer projected part 73 which is formed on an outer surface thereof and engages the plunger-mounting member removal prevention rib 62 of the gasket body 6, thus preventing the plunger-mounting member 7 from separating from the gasket body 6, a plurality of elastically deformable inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f which are extended obliquely from an inner portion of a proximal side of the plunger-mounting member 7 toward a central and distal end thereof and have a free end respectively at a position which does not reach the center of the plunger-mounting member, and a plurality of plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f formed at the free ends of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f respectively. The plunger 4 has a pressing part 45 capable of pressing a proximal end portion 67 of the gasket body 6 in an operation of mounting the plunger 4 on the gasket 3, a distal end part 42 (in this embodiment, tubular distal end part) which is projected from the pressing part 45 toward the distal end of the plunger 4 and capable of entering the plunger-mounting member 7, and an outer projection part 43 which is disposed on the outer surface of the tubular distal end part 42 and engages the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f of the plunger-mounting member 7. A plurality of ribs 68 is formed on the proximal end surface (rear end portion) of the gasket body 6 of this embodiment. The plunger-mounting member 7 is mounted on the gasket body 6 in a state in which the plunger-mounting member removal prevention rib 62 of the gasket body 6 and the outer pro-

jected part 73 of the plunger-mounting member 7 have engaged each other. When the plunger 4 is mounted on the gasket 3, the distal end of the tubular distal end part 42 of the plunger 4 does not contact the inner surface of the gasket body 6.

[0012] The prefilled syringe 1 of this embodiment is composed of the prefilled syringe body 10 and the plunger 4 mounted on the prefilled syringe body 10 (gasket 3). The prefilled syringe body 10 has the outer cylinder 2, the sealing member 5 which seals the opening formed at the distal end of the outer cylinder 2, the gasket 3 slidably accommodated inside the outer cylinder 2, and the medical agent 8 accommodated inside the medical agent accommodation part formed inside the outer cylinder 2.

The gasket 3 is composed of the gasket body 6 and the plunger-mounting member 7 mounted thereon.

As shown in Figs. 1 through 7, the gasket body 6 is the tubular body having the closed distal end and the inner cavity 60 extended from the opening formed at the proximal end of the gasket body 6 toward the distal end thereof. The gasket body 6 has a tapered part 61, the diameter of which taperingly decreases toward the distal end thereof. The gasket body 6 has a distal side annular rib 63 formed at the distal side of the outer surface thereof and a proximal side annular rib 64 formed at the proximal side of the outer surface thereof.

[0013] The gasket body 6 has the inner cavity 60 which is an accommodation part accommodating the plunger-mounting member. The inner cavity 60 has the plunger-mounting member removal prevention rib 62 formed on the inner surface thereof. In this embodiment, the plunger-mounting member removal prevention rib 62 is disposed at the distal side of the inner cavity 60. The plunger-mounting member removal prevention rib 62 is formed as an endless annular rib almost orthogonal to the axis of the gasket body 6. Although it is preferable that the plunger-mounting member removal prevention rib 62 is formed as the annular rib, plunger-mounting member removal prevention rib 62 may be formed as a plurality of uncontinuous ribs disposed on the same circumference. A distal end surface of the plunger-mounting member removal prevention rib 62 is formed as an annular erect surface 62a erect from the inner surface of the inner cavity 60. A proximal end surface of the plunger-mounting member removal prevention rib 62 is formed as an annular inclined surface 62b the diameter of which increases toward the proximal end thereof. It is preferable that the plunger-mounting member removal prevention rib 62 has an equal inner diameter portion which has a substantially equal inner diameter and is extended in a predetermined length. By providing the plunger-mounting member removal prevention rib 62 with the equal inner diameter portion, it is possible to securely prevent the plunger-mounting member from separating from the gasket body when the plunger is pulled rearward. The height of the plunger-mounting member removal prevention rib 62 is favorably 0.5 to 2.0mm and especially favorably 1.0

to 1.5mm. The length of the equal inner diameter portion of the plunger-mounting member removal prevention rib 62 is favorably 1.0 to 6.0mm and especially favorably 2.0 to 4.0mm.

[0014] The gasket body 6 has a projection part 66 projected from the central portion of the inner surface of the distal end portion thereof toward the proximal side thereof. The projection part 66 is capable of contacting the distal end of the tubular distal end part 42 of the plunger 4, when the distal end portion of the gasket body 6 deforms toward its proximal side, thus preventing the distal end portion of the gasket body 6 from excessively deforming. It is preferable that the projection part 66 is approximately semispherical. Generally the diameter of the gasket body 6 is 5 to 30mm, and the whole length thereof is 5 to 30mm.

As constituent materials of the gasket body 6, known materials conventionally used for the gasket can be used. For example, rubber, elastomer, polyolefin resin, fluororesin, and polyester resin are listed. As the rubber, natural rubber, isoprene rubber, butyl rubber, chloroprene rubber, nitrile-butadiene rubber, styrene butadiene rubber, and silicone rubber are favorable. It is especially favorable to vulcanize the above-described rubbers. As the elastomer, polyvinyl chloride elastomer, polyolefin elastomer, styrene elastomer, polyester elastomer, polyamide elastomer, polyurethane elastomer, and mixtures of these elastomers are favorable. Of the above-described rubbers and elastomers, the styrene butadiene rubber, the butyl rubber, and the styrene elastomer are preferable because these materials have suitable hardnesses and elastic properties and various sterilization methods such as y ray sterilization, electron beam sterilization, and high-pressure steam sterilization can be adopted therefor.

[0015] The distal end of the gasket body 6 may be coated with a medical agent low absorption substance or the like.

As materials of a medical agent low absorption layer, known materials which are conventionally used for a laminate gasket can be used. As the materials of the low-degree medical agent absorption layer, polyolefin resin, fluororesin, polyester resin, and poly-para-xylylene are listed. Specifically, as the polyolefin resin, polypropylene, ultra-high-molecular-weight polyethylene, poly (4-methylpentene-1), and cyclic polyolefin are preferable. As the fluororesin, a tetrafluoroethylene-perfluoroethoxyethylene copolymer, polytetrafluoroethylene, a tetrafluoroethylene/perfluoroalkyl vinyl ether copolymer, a tetrafluoroethylene/hexafluoropropylene copolymer are preferable.

It is preferable to apply a lubricant to the outer surface of the gasket body 6 and to at least the surface of the distal side annular rib 63 and that of the proximal side annular rib 64. The lubricant may be applied to the inner surface of the outer cylinder. As the lubricant, silicone oil is suitable.

By forming a silicone resin layer on the surface of the

gasket body by solidifying the silicone resin, it is possible to eliminate the need for the use of the lubricant such as the silicone oil.

[0016] As shown in Figs. 2, 4, 8 through 12, the plunger-mounting member 7 is a tubular body which has the hollow portion penetrating therethrough from a distal end thereof to a proximal end thereof. The plunger-mounting member 7 has a body part 71 which can be accommodated inside the inner cavity 60 of the gasket body 6, the outer projected part 73 formed on the outer surface of the body part 71, a plurality of the elastically deformable inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f, and the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f formed at the free ends of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f respectively.

The outer projected part 73 engages the plunger-mounting member removal prevention rib 62 of the gasket body 6, thus preventing the plunger-mounting member 7 from separating from the gasket body 6. In the plunger-mounting member 7 of this embodiment, the outer projected part 73 is formed on the outer surface of the distal end portion (specifically, the outer surface of the distal end) of the body part 71 as the annular projected part almost orthogonal to the axis of the plunger-mounting member 7. The proximal end surface of the outer projected part (outer annular projected part) 73 is formed as an annular erect surface 73a erect from the outer surface of the body part 71. The outer projected part 73 is not limited to an annular configuration, but may be constructed of a plurality of uncontinuous projected parts. The height of the outer projected part 73 is favorably 0.5 to 2.0mm and especially favorably 1.0 to 1.5mm. The outer diameter of the outer projected part 73 of the plunger-mounting member 7 is larger than the inner diameter of the plunger-mounting member removal prevention rib 62 of the gasket body 62 by 1.0 to 4.0mm and more favorably by 2.0 to 3.0mm.

[0017] As shown in Figs. 4, 9 through 12, the plunger-mounting member 7 has a plurality of the elastically deformable inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f which are extended obliquely from the inner portion of a proximal end 72 of the plunger-mounting member 7 (body part 71) toward the central and distal end thereof and have the free end at the position respectively which does not reach the center of the plunger-mounting member 7. There are formed the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f at the free ends of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f respectively. The plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f are engageable with the outer projection part 43 formed on the outer surface of the tubular distal end part 42 of the plunger 4 to be described later. The body part 71 is a cylindrical part having an almost equal outer diameter and extending in a predetermined length and accommodates the tubular distal end part 42 of the plunger 4 to be described later.

In the plunger-mounting member 7 of this embodiment, each of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f is extended obliquely at a predetermined angle from the inner portion of the proximal end 72 of the plunger-mounting member 7 (body part 71) toward the central and distal end thereof. Each of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f has the free end at the position which does not reach the center of the plunger-mounting member and becomes smaller toward the free end in the width thereof. In this embodiment, each of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f becomes gradually smaller toward the free end in the width thereof.

In the plunger-mounting member 7 of this embodiment, the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f are formed on the distal end surfaces of the free ends of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f of the plunger-mounting member respectively. The plunger removal prevention locking parts (distal end surfaces of the free ends) 76a, 76b, 76c, 76d, 76e, and 76f are formed as flat surfaces almost orthogonal to the axis of the plunger-mounting member 7. "Almost orthogonal" herein means a concept including inclinations less than ± 20 degrees with respect to "orthogonal" (90 degrees). In this embodiment, the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f incline about 10 degrees with respect to "orthogonal" (90 degrees).

It is preferable to form not less than two inner projected parts almost equiangularly with respect to the axis of the plunger-mounting member 7. The number of the inner projected parts is preferably four to eight.

[0018] Each of the inner projected parts of the plunger-mounting member is elastically deformable. When the inner projected parts are pressed toward the proximal end thereof, the free ends of the inner projected parts deform in a direction in which the free ends become close to the center of the plunger-mounting member. When the inner projected parts are pressed toward the distal end thereof, the free ends deform in a direction in which the free ends become distant from the center of the plunger-mounting member.

In the plunger-mounting member 7 of this embodiment, the proximal end surfaces of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f of the plunger-mounting member 7 are formed as flat and smooth inclined surfaces inclined toward the center of the plunger-mounting member to form a guide portion for guiding the engagement between the engaging part of the plunger 4 and the locking parts of the plunger-mounting member. It is preferable that the inner surfaces of the free ends of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f of the plunger-mounting member 7 form a circular-arc surface whose center almost aligns with the axis of the plunger-mounting member 7.

As shown in Fig. 4, the plunger-mounting member 7 is mounted on the gasket body 6 in the state in which the plunger-mounting member removal prevention rib 62 of

the gasket body 6 and the outer projected part 73 of the plunger-mounting member 7 have engaged each other. The proximal end of the plunger-mounting member 7 mounted on the gasket body 6 does not project beyond the gasket body 6. In other words, in a state in which the plunger-mounting member 7 has been mounted on the gasket body 6, the proximal end of the plunger-mounting member 7 is located at a position distal from the proximal end of the gasket body by a predetermined length. In the state in which the plunger-mounting member 7 has been mounted on the gasket body 6, the body part 71 of the plunger-mounting member 7 is not pressed against the plunger-mounting member removal prevention rib 62 nor the outer projected part 73 of the plunger-mounting member 7 is pressed against the inner surface of the inner cavity 60 of the gasket body 61. Therefore when the plunger-mounting member is mounted on the gasket body 6, the plunger-mounting member 7 is rotatable and a little longitudinally movable inside the gasket body 6. It is favorable that the outer diameter of the plunger-mounting member 7 of the body part 71 is larger than the inner diameter of the plunger-mounting member removal prevention rib 62 of the gasket body 6 by 1.0 to 4.0mm and more favorable that the outer diameter of the outer projected part 73 is larger than the inner diameter of the plunger-mounting member removal prevention rib 62 by 2.0 to 3.0mm.

It is preferable to use hard or semi-hard resin such as high-density polyethylene, polypropylene, polystyrene, and polyethylene terephthalate for materials composing the plunger-mounting member 7.

[0019] As shown in Figs. 1, 2, 13 through 15, the plunger 4 has a plunger body part 41, the pressing part 45 capable of pressing the proximal end surface of the gasket 3 when the plunger 4 is mounted on the gasket 3, the tubular distal end part 42 projected from the pressing part 45 toward the distal end of the plunger 4 and is capable of penetrating into the hollow portion of the plunger-mounting member 7, and the outer projection part 43 which is disposed on the outer surface of the tubular distal end part 42 and engages the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f of the plunger-mounting member 7. Although it is preferable that the distal end part 42 is tubular, the configuration thereof is not limited to the tubular configuration, but may be solid.

The plunger 4 can be mounted on the plunger-mounting member 7 by pressing the distal end part 42 into the hollow portion of the plunger-mounting member 7. In the state in which the plunger 4 is mounted on the gasket 3, the distal end part 42 of the plunger 4 does not contact the inner surface of the gasket body 6.

The pressing part 45 is positioned at the distal end of the plunger body part 41 and formed in the shape of a disk. As shown in Figs. 13 and 15, the plunger body part 41 is formed in the shape of a cross. The pressing part 45 is disposed at the distal end of the plunger body part 41. A disk-shaped proximal end pressing part 47 is formed

at the proximal end of the body part 41. The plunger 4 has a reinforcing rib 48 disposed midway between the pressing part 45 and the proximal end pressing part 47. As materials composing the plunger 4, it is preferable to use the hard resin or the semi-hard resin such as the high-density polyethylene, the polypropylene, polystyrene, and the polyethylene terephthalate.

[0020] In the plunger 4 of this embodiment, the outer projection part 43 which engages the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f of the plunger-mounting member 7 is formed on the outer surface of the distal end portion (specifically, outer surface of distal end) of the tubular distal end part 42 as the annular outer projection part almost orthogonal to the axis of the tubular distal end part 42 of the plunger 4. The proximal end surface of the outer projection part (outer annular projection part) 43 is formed as an annular erect surface erect from the outer surface of the tubular distal end part 42. The tubular distal end part 42 is not necessarily limited to the annular configuration, but may consist of a plurality of uncontinuous projections. The height of the outer projection part 43 is favorably 0.3 to 1.5mm and especially favorably 0.5 to 1.0mm. The outer diameter of the plunger 4 at the outer projection part 43 thereof is larger than the diameter of the circle formed of the inner surfaces of the free ends of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f of the plunger-mounting member 7 by 0.5 to 3.0mm and more favorably by 1.0 to 2.0mm.

By pressing the tubular distal end part 42 of the plunger 4 including the outer projection part 43 into the hollow portion of the plunger-mounting member 7, the outer projection part 43 presses and elastically deforms the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f of the plunger-mounting member 7 and passes through inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f. Thereafter the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f are restored to the original configuration thereof or to an almost original configuration thereof. Thereby the proximal end surface of the outer projection part 43 engages the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f. Thus the plunger 4 is prevented from separating from the plunger-mounting member 7.

[0021] In the plunger 4 of this embodiment, in a state in which the plunger 4 has been mounted on the plunger-mounting member 7, the inner surface of the free end of each of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f is in contact with the outer surface of the tubular distal end part 42 of the plunger 4. As shown in Fig. 16, in the state in which the plunger 4 has been mounted on the plunger-mounting member 7, the inner surface of the free end of each of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f may contact the outer surface of the tubular distal end part 42 of the plunger 4 under pressure with the inner surface of the free end of each of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f being pressed a little in a direction in which the free ends

thereof are expanded a little. In this way, the gasket is prevented from loosening.

As shown in Figs. 1, 2, and 16, in the prefilled syringe of this embodiment, the gasket 3 is disposed at a position distal from the proximal end of the outer cylinder in a predetermined length, and the pressing part 45 of the plunger 4 mounted on the plunger-mounting member 7 is positioned inside the outer cylinder. Thereby the gasket mounted in the outer cylinder is prevented from inclining.

[0022] The outer cylinder 2 has a outer cylinder body part 21, a nozzle part 22 disposed at the distal end portion of the outer cylinder body part 21, and a flange 24 disposed at the proximal end portion of the outer cylinder body part 21.

The body part 21 of the outer cylinder is an almost tubular part accommodating the gasket 3 liquid-tightly and slidably. The nozzle part 22 is a tubular part having a smaller diameter than the outer cylinder body part 21 of the outer cylinder. The distal end portion (shoulder part) of the outer cylinder body part 21 becomes taperingly smaller toward the nozzle part 22.

The outer cylinder 2 is a tubular body formed of a transparent or semitransparent material and formed of preferably a low oxygen-permeable and vapor-permeable material.

As shown in Figs. 1 and 17, the flange 24 is an elliptic donut-shaped disk part projected vertically from the entire circumference of the proximal end of the outer cylinder body part 21. The flange 24 has two wide gripping portions opposed to each other. A plurality of ribs is formed on the distal end surface of each gripping portion. The proximal end surface of the flange 24 is formed as a concave part except the peripheral portion of the flange 24 and a portion of the flange 24 formed on the proximal end portion of the outer cylinder as rib portions.

As shown in Fig. 17, the nozzle part 22 has a needle-mounting portion, the diameter of which decreases toward its distal end. In this embodiment, a nozzle-side screwing portion 23 is formed at a position proximal from a tip portion. Although the sealing member 5 is mounted on the outer cylinder by means of the nozzle-side screwing portion 23 in this embodiment, the sealing member 5 may be mounted thereon by other means.

As shown in Fig. 17, in this embodiment, the nozzle part 22 has a base portion 25 disposed between the proximal end of the tip and the body part 21 of the outer cylinder. The nozzle part 22 has a nozzle-side engaging portion 26 formed on the side surface of the base portion 25. The nozzle-side engaging portion 26 is formed of a rib.

[0023] As materials forming the outer cylinder 2, various resins such as polypropylene, polyethylene, polystyrene, polyamide, polycarbonate, polyvinyl chloride, poly-(4-methylpentene-1), acrylic resin, acrylonitrile-butadiene-styrene copolymer, polyester such as polyethylene terephthalate, and cyclic polyolefin are listed. Of these resins, resins such as the polypropylene and the cyclic polyolefin are preferable because these resins can be easily molded and are heat-resistant. As the materials

forming the outer cylinder 2, to enhance the sealing performance, it is preferable to use resins having a higher hardness than the material of the sealing member. Thereby, in an operation of mounting the sealing member 5 on the nozzle part 22, the sealing member 5 adheres to the nozzle part 22 by performing a screwing operation and thus the sealing performance can be further enhanced. As the medicinal solution 8 to be filled inside the syringe body 10, it is possible to use any medicinal solution. For example, a high concentration sodium chloride injection solution, minerals, a heparin sodium water solution, nitroglycerin, isosorbide dinitrate, cyclosporine, benzodiazepine-based medical agent, antibiotics, a vitamin preparation (multi vitamin preparation), various amino acids, an antithrombotic drug such as heparin, insulin, antitumor medicine, pain killers, a cardiotoxic drug, an intravenous anesthetic, an antiparkinsonism drug, a tumor therapeutic drug, adrenal corticosteroid, a drug for irregular heartbeat, a correction electrolyte, an antiviral drug, and immunomodulator are listed. Medicinal solutions which require continued infinitesimal administration by setting syringe pump are particularly preferable.

[0024] The sealing member 5 is described below.

As the sealing member 5, a sealing cap or a needle (not shown) may be used. Known sealing caps or needles are used.

As shown in Fig. 18, the sealing member 5 of this embodiment is the sealing cap constructed of an inner cylindrical part 52 having an obstruction portion 53, an outer cylindrical part 51 so formed as to surround the inner cylindrical part 52, and a coupling part 55 coupling the inner cylindrical part 52 and the outer cylindrical part 51 to each other. In the sealing member 5, the inner cylindrical part 52 and the outer cylindrical part 51 are integrated with the coupling part 55 on the entire circumference of the proximal end portion thereof.

As shown in Fig. 18, the sealing member 5 has a tip portion accommodation part 57 accommodating a needle-mounting tip portion of the nozzle part 22 of the outer cylinder 2, a cap-side screwing part 54 which screws on the nozzle-side screwing portion 23, and a sealing member 56 which seals the opening formed at the distal end of the tip portion with the sealing member 56 in contact with an aperture plane disposed at the distal end thereof. The proximal end portion of the inner cylindrical part 52 is formed as a columnar space having almost an equal inner diameter. The cap-side screwing part 54 which engages the nozzle-side screwing portion 23 is disposed on the inner surface of the inner cylindrical part 52. In this embodiment, the cap-side screwing part 54 is composed of two spiral portions. As materials forming the sealing member, it is preferable to use natural rubber, isoprene rubber, butadiene rubber, fluorine rubber, synthetic rubber such as silicone rubber, thermoplastic elastomers such as olefin-based elastomers, styrene-based elastomers and the like.

As shown in Fig. 18, in this embodiment, the sealing member 5 has a sealing member-side engaging part 58

which is formed on the inner surface of an opening formed at the proximal end thereof and engageable with the nozzle-side engaging portion 26 of the outer cylinder. The sealing member-side engaging part 58 is constructed of a concave portion formed between two ribs.

As materials forming the sealing cap used as the sealing member 5, various resins such as polypropylene, polyethylene, polystyrene, polyamide, polycarbonate, polyvinyl chloride, poly-(4-methylpentene-1), acrylic resin, acrylonitrile-butadiene-styrene copolymer, polyester such as polyethylene terephthalate, and cyclic polyolefin are listed. Of these resins, resins such as the polypropylene and the cyclic polyolefin are preferable because these resins can be easily molded and are heat-resistant.

[0025] The operation of the prefilled syringe 1 of the present invention is described below by using Fig. 16.

In the body 10 of the prefilled syringe, the gasket 3 is accommodated in the proximal end portion of the outer cylinder 2. As shown in Fig. 16, the tubular distal end part 42 of the plunger 4 is inserted into the outer cylinder 2 and thereafter entered into the hollow portion of the plunger-mounting member 7 and pressed therein. Thereby the outer projection part 43 formed on the outer surface of the tubular distal end part 42 of the plunger 4 presses and elastically deforms the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f of the plunger-mounting member 7, thus passing through the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f. Thereafter the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f are restored to the original configuration thereof or to an almost original configuration thereof. Thereby the proximal end surface of the outer projection part 43 engages the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f. Thus the plunger 4 is prevented from separating from the plunger-mounting member 7. In the plunger 4 of this embodiment, in a state in which the plunger 4 is mounted on the plunger-mounting member 7, the plunger 4 is a little longitudinally movable.

As described above, in the prefilled syringe, the plunger can be mounted on the plunger-mounting member by merely pressing the plunger into the plunger-mounting member without rotating the plunger. Further because the plunger can be smoothly inserted into the plunger-mounting member, it is possible to restrain an impact from being applied to the gasket body and prevent the medicinal solution from leaking when an operation of mounting the plunger on the plunger-mounting member is performed. The plunger mounted on the plunger-mounting member 7 does not separate therefrom. When the plunger mounted on the plunger-mounting member 7 is rotated, there is a possibility that only the plunger 4 rotates inside the plunger-mounting member 7 or the rotation of the plunger 4 causes the plunger-mounting member 7 to rotate. But the rotation of the plunger 4 is not transmitted to the gasket body 6.

[0026] The gasket is not limited to the above-described gasket 3, but it is possible to use a gasket 3a as shown in Figs. 19 through 27 for the prefilled syringe of the

present invention.

Fig. 19 is an enlarged front view of a gasket for use in a prefilled syringe of another embodiment of the present invention. Fig. 20 is a sectional view taken along a line E-E of Fig. 19. Fig. 21 is a vertical sectional view of a gasket body for use in the gasket shown in Fig. 19. Fig. 22 is a front view of a gasket-mounting member for use in the gasket shown in Fig. 19. Fig. 23 is a sectional view taken along a line F-F of Fig. 22. Fig. 24 is a plan view of the gasket-mounting member shown in Fig. 22. Fig. 25 is a perspective view of the gasket-mounting member shown in Fig. 22 as viewed from a distal side thereof. Fig. 26 is a perspective view of the gasket-mounting member shown in Fig. 22 as viewed from a proximal side thereof. Fig. 27 is an explanatory view for explaining an operation of mounting the plunger on the body of the prefilled syringe of the present invention in which the gasket shown in Fig. 19 is used.

[0027] The fundamental construction of the gasket 3a is the same as the above-described gasket 3.

The gasket 3a is a tubular body whose distal end is closed and proximal end is open and composed of a gasket body 6a which has the inner cavity 60 extended from the opening formed at the proximal end thereof to the distal end thereof and a plunger-mounting member 7a mounted on the gasket body 6a.

The gasket body 6a has a plunger-mounting member removal prevention rib 83 and a plunger-mounting member movement prevention rib 82 both formed on the inner surface of the inner cavity 60. An annular concave portion is formed between the plunger-mounting member removal prevention rib 83 and the plunger-mounting member movement prevention rib 82.

As shown in Figs. 19 through 21, the gasket body 6a is the tubular body having the closed distal end and the inner cavity 60 extended from the opening formed at the proximal end thereof toward the distal end thereof. The gasket body 6a has the tapered part 61, the diameter of which taperingly decreases toward the distal end thereof. The gasket body 6a has the distal side annular rib 63 formed at the distal side of the outer surface thereof and the proximal side annular rib 64 formed at the proximal side of the outer surface thereof.

As shown in Fig. 21, the gasket body 6a has the inner cavity 60 which is an accommodation part accommodating the plunger-mounting member 7a. The inner cavity 60 has the plunger-mounting member removal prevention rib 83 and the plunger-mounting member movement prevention rib 82 both formed on the inner surface thereof. In this embodiment, the plunger-mounting member removal prevention rib 83 is disposed at the proximal side (in the vicinity of the opening) of the inner cavity 60, and the plunger-mounting member movement prevention rib 82 is located at a position a little distal from the plunger-mounting member removal prevention rib 83.

[0028] The plunger-mounting member removal prevention rib 83 is formed as an endless annular rib almost orthogonal to the axis of the gasket body 6a. Although it

is preferable that the plunger-mounting member removal prevention rib 83 is formed as the annular rib, the plunger-mounting member removal prevention rib 83 may be formed as a plurality of uncontinuous ribs disposed on the same circumference. A distal end surface of the plunger-mounting member removal prevention rib 83 is formed as an annular erect surface 83a erect from the inner surface of the inner cavity 60. A proximal end surface of the plunger-mounting member removal prevention rib 83 is formed as an annular inclined surface 83b, the diameter of which increases toward the proximal end thereof. It is preferable that the plunger-mounting member removal prevention rib 83 has an equal inner diameter portion which has a substantially equal inner diameter and is extended in a predetermined length. Because the plunger-mounting member removal prevention rib 83 has the equal inner diameter portion, it is possible to securely prevent the plunger-mounting member from separating from the gasket body when the plunger is pulled toward the proximal end thereof. The height of the plunger-mounting member removal prevention rib 83 is favorably 0.5 to 2.0mm and especially favorably 1.0 to 1.5mm. The length of the equal inner diameter portion of the plunger-mounting member removal prevention rib 83 is favorably 1.0 to 6.0mm and especially favorably 2.0 to 4.0mm.

[0029] In this embodiment, the plunger-mounting member movement prevention rib 82 is located at a position a little proximal from a central portion of the inner cavity 60. The plunger-mounting member movement prevention rib 82 is located at the position a little distal from the plunger-mounting member removal prevention rib 83. As with the removal prevention rib 83, the plunger-mounting member movement prevention rib 82 is formed as an endless annular rib almost orthogonal to the axis of the gasket body 6a. Although it is preferable that the plunger-mounting member movement prevention rib 82 is formed as the annular rib, plunger-mounting member movement prevention rib 82 may be formed as a plurality of uncontinuous ribs disposed on the same circumference. A proximal end surface of the plunger-mounting member movement prevention rib 82 is formed as an annular erect surface erect from the inner surface of the inner cavity 60. A distal end surface of the plunger-mounting member movement prevention rib 82 is formed as an annular inclined surface, the diameter of which increases toward the distal end thereof. It is preferable that the plunger-mounting member removal prevention rib 83 has an equal inner diameter portion which has a substantially equal inner diameter and is extended in a predetermined length. The height of the plunger-mounting member movement prevention rib 82 is set a little lower than that of the plunger-mounting member removal prevention rib 83. The height of the plunger-mounting member movement prevention rib 82 is favorably 0.3 to 3.0mm and especially favorably 1.0 to 2.0mm. The length of the equal inner diameter portion of the plunger-mounting member movement prevention rib 82 is favorably 1.0 to 6.0mm and especially favorably 2.0 to 4.0mm.

In this embodiment, as shown in Fig. 21, the gasket body 6a has the concave portion formed between the plunger-mounting member removal prevention rib 83 and the plunger-mounting member movement prevention rib 82. It is preferable that the concave portion is annular. The concave portion (annular concave portion) is capable of accommodating an outer projected part 77 of the plunger-mounting member 7a. The width (length in width direction) of the concave portion (annular concave portion) is preferably 1.0 to 6.0mm.

[0030] The gasket body 6a has the projection part 66 projected from the central portion of the inner surface of the distal end portion thereof toward the proximal side thereof. The projection part 66 is capable of contacting the distal end of the tubular distal end part 42 of the plunger 4, when the distal end portion of the gasket body 6a deforms toward its proximal side, thus preventing the distal end portion of the gasket body 6a from excessively deforming. It is preferable that the projection part 66 is approximately semispherical. Generally the diameter of the gasket body 6a is 5 to 30mm, and the whole length thereof is 5 to 30mm.

As shown in Fig. 21, in this embodiment, the gasket body 6a has a plunger-mounting member contact part 69 on the inner surface of the distal end portion of the inner cavity 60. The plunger-mounting member contact part 69 is formed as an annular surface facing toward the proximal side of the gasket body 6a. As shown in Fig. 20, the distal end surface of the plunger-mounting member 7a is capable of contacting the plunger-mounting member contact part 69. The plunger-mounting member contact part 69 surrounds the projection part 66. Although it is preferable that the plunger-mounting member contact part 69 is formed as the annular surface, the plunger-mounting member contact part 69 may be formed as an annular rib facing the proximal side of the gasket body 6a or as a plurality of uncontinuous ribs facing the proximal side thereof.

As constituent materials of the gasket body 6a, it is possible to preferably use the above-described materials described as being preferable for the gasket body 6. The distal end of the gasket body 6a may be coated with the medical agent low adsorptive substance. As materials forming the medical agent low adsorptive layer, the above-described materials can be preferably used. A lubricant is applied to the outer surface of the gasket body 6a. It is preferable to apply the lubricant to at least the surface of the distal side annular rib 63 and that of the proximal side annular rib 64. The lubricant may be applied to the inner surface of the outer cylinder. As the lubricant, silicone oil is suitable. By forming a silicone resin layer on the surface of the gasket body by solidifying the silicone resin, it is possible to eliminate the need for the use of the lubricant such as the silicone oil.

[0031] As with the above-described plunger-mounting member 7 and as shown in Figs. 21 through 27, the plunger-mounting member 7a is a tubular body having a hollow portion penetrating therethrough from a distal end thereof

to a proximal end thereof and can be accommodated inside the inner cavity 60 of the gasket body 6a. The plunger-mounting member 7a has the outer projected part 77 which is formed on the outer surface thereof and engages the plunger-mounting member removal prevention rib 83 of the gasket body 6a, thus preventing the plunger-mounting member 7a from separating from the gasket body 6a, a plurality of the elastically deformable inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f which are extended obliquely from an inner portion of a proximal side of the plunger-mounting member 7a toward a central and distal end thereof and have a free end respectively at a position which does not reach the center thereof, and a plurality of the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f formed at the free ends of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f respectively. As shown in Fig. 27, the plunger 4 has the pressing part 45 capable of pressing the proximal end portion 67 of the gasket body 6a in an operation of mounting the plunger 4 on the gasket 3a, the tubular distal end part 42 projected from the pressing part 45 toward the distal end thereof and being capable of penetrating into the plunger-mounting member 7a, and the outer projection part 43 which is disposed on the outer surface of the tubular distal end part 42 and engages the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f of the plunger-mounting member 7a. A plurality of ribs 68 is formed on the proximal end surface (proximal end portion) 67 of the gasket body 6a of this embodiment.

[0032] The outer projected part 77 engages the plunger-mounting member removal prevention rib 83 of the gasket body 6a, thus preventing the plunger-mounting member 7a from separating from the gasket body 6a. In the plunger-mounting member 7a of this embodiment, the outer projected part 77 is formed on the outer surface of the proximal end portion of the body part 71 (specifically, the outer surface of the proximal end of the body part) as an annular projected part almost orthogonal to the axis of the plunger-mounting member 7a. The proximal end surface of the outer projected part (annular projected part formed on the outer surface) 73 is formed as an annular erect surface erect from the outer surface of the body part 71. The outer projected part 77 is not limited to the annular configuration, but may be constructed of a plurality of uncontinuous projected parts. The height of the outer projected part 77 is favorably 0.5 to 2.0mm and especially favorably 1.0 to 1.5mm. The outer diameter of the plunger-mounting member 7a at the outer projected part 77 thereof is larger than the inner diameter of the plunger-mounting member removal prevention rib 83 of the gasket body 6a by 1.0 to 4.0mm and more favorably by 2.0 to 3.0mm.

[0033] The plunger-mounting member 7a is mounted on the gasket body 6a in a state in which the plunger-mounting member removal prevention rib 83 of the gasket body 6a and the outer projected part 77 of the plunger-mounting member 7a have engaged each other. In this

embodiment, the outer projected part 77 of the plunger-mounting member 7a is accommodated inside the annular concave portion formed between the plunger-mounting member removal prevention rib 83 and the plunger-mounting member movement prevention rib 82 of a plunger body 3a. In the gasket 3a of this embodiment, the plunger-mounting member 7a is a little movable inside the gasket body 6a. But in the gasket 3a of the type of this embodiment, the proximal end surface of the outer projected part 77 of the plunger-mounting member 7a may contact the distal end surface of the plunger-mounting member removal prevention rib 83, and the distal end surface of the distal end portion of the plunger-mounting member 7a may contact the plunger-mounting member contact part 69 of the gasket body 6a. That is, the plunger-mounting member 7a may be held by the plunger-mounting member contact part 69 of the gasket body 6a and the plunger-mounting member removal prevention rib 83 and prevented from moving inside the gasket body 6a. The proximal end of the plunger-mounting member 7a mounted on the gasket body 6a does not project beyond the gasket body 6a. In other words, in a state in which the plunger-mounting member 7a has been mounted on the gasket body 6a, the proximal end of the plunger-mounting member 7a is located at a position distal from the proximal end of the gasket body by a predetermined length. As shown in Fig. 27, in a syringe using the gasket 3a of this embodiment, when the plunger 4 is mounted on the gasket 3a, the distal end of the tubular distal end part 42 of the plunger 4 does not contact the inner surface of the gasket body 6a.

[0034] As with the plunger-mounting member 7 and as shown in Figs. 23 through 27, the plunger-mounting member 7a has a plurality of the elastically deformable inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f which are extended obliquely from the inner portion of the proximal end 72 of the plunger-mounting member 7a (body part 71) toward the central and distal end thereof and have the free end respectively at the position which does not reach the center of the plunger-mounting member 7a. There are formed the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f at the free ends of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f respectively. The plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f are engageable with the outer projection part 43 formed on the outer surface of the tubular distal end part 42 of the plunger 4 to be described later respectively. The body part 71 is the cylindrical part having an almost equal outer diameter and extending in a predetermined length and accommodating the tubular distal end part 42 of the plunger 4 to be described later.

In the plunger-mounting member 7a of this embodiment, each of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f is extended obliquely at a predetermined angle from the inner portion of the proximal end 72 of the plunger-mounting member 7a (body part 71) toward the central and distal end thereof. Each of the inner projected parts

75a, 75b, 75c, 75d, 75e, and 75f has the free end at the position which does not reach the center of the plunger-mounting member and becomes smaller toward the free end in the width thereof. In this embodiment, each of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f becomes smaller toward the free end in the width thereof.

[0035] In the plunger-mounting member 7a of this embodiment, the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f are formed on the distal end surfaces of the free ends of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f of the plunger-mounting member respectively. The plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f are formed as flat surfaces almost orthogonal to the axis of the plunger-mounting member 7a. "Almost orthogonal" herein means the concept including inclinations less than ± 20 degrees with respect to "orthogonal" (90 degrees). In this embodiment, the plunger removal prevention locking parts 76a, 76b, 76c, 76d, 76e, and 76f incline about 10 degrees with respect to "orthogonal" (90 degrees).

It is preferable to form not less than two inner projected parts almost equiangularly with respect to the axis of the plunger-mounting member 7a. The number of the inner projected parts is preferably four to eight.

Each of the inner projected parts of the plunger-mounting member is elastically deformable. When the inner projected parts are pressed toward the proximal end thereof, the free ends of the inner projected parts deform in a direction in which the free ends become close to the center of the plunger-mounting member. When the inner projected parts are pressed toward the distal end thereof, the free ends deform in a direction in which the free ends become distant from the center of the plunger-mounting member.

[0036] In the plunger-mounting member 7a of this embodiment, the proximal end surfaces of a plurality of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f of the plunger-mounting member 7a are formed as flat and smooth inclined surfaces inclined toward the center of the plunger-mounting member to form the guide portion for guiding the engagement between the engaging part of the plunger 4 and the locking parts of the plunger-mounting member. It is preferable that the inner surfaces of the free ends of the inner projected parts 75a, 75b, 75c, 75d, 75e, and 75f of the plunger-mounting member 7a form a circular-arc surface whose center almost aligns with the axis of the plunger-mounting member 7a.

As shown in Fig. 27, the plunger-mounting member 7a is mounted on the gasket body 6a in the state in which the plunger-mounting member removal prevention rib 83 of the gasket body 6a and the outer projected part 77 of the plunger-mounting member 7a have engaged each other.

As materials composing the plunger-mounting member 7a, it is preferable to use the hard resin or the semi-hard resin such as the high-density polyethylene, the polypropylene, the polystyrene, and the polyethylene terephthalate.

[0037] The gasket is not limited to the above-described gasket 3, but it is possible to use a gasket 3b as shown in Figs. 28 through 33 for the prefilled syringe of the present invention.

Fig. 28 is an enlarged front view of a gasket for use in a prefilled syringe of another embodiment of the present invention. Fig. 29 is a sectional view taken along a line G-G of Fig. 28. Fig. 30 is a vertical sectional view of a gasket body for use in the gasket shown in Fig. 28. Fig. 31 is a front view of a gasket-mounting member for use in the gasket shown in Fig. 28. Fig. 32 is a sectional view taken along a line H-H of Fig. 31. Fig. 33 is an explanatory view for explaining an operation of mounting the plunger on the body of the prefilled syringe of the present invention in which the gasket shown in Fig. 28 is used.

[0038] The fundamental construction of the gasket 3b is the same as the above-described gasket 3.

The gasket 3b is a tubular body whose distal end is closed and proximal end is open and composed of a gasket body 6b which has the inner cavity 60 extended from the opening formed at the proximal end thereof to the distal end thereof and a plunger-mounting member 7b mounted on the gasket body 6b.

The gasket body 6b has the plunger-mounting member removal prevention rib 83 formed on the inner surface of the inner cavity 60.

As shown in Figs. 28 through 30, the gasket body 6b is the tubular body having the closed distal end and the inner cavity 60 extended from the opening formed at the proximal end of the gasket body 6b toward the distal end thereof. The gasket body 6b has the tapered part 61, the diameter of which taperingly decreases toward the distal end thereof. The gasket body 6b has the distal side annular rib 63 formed at the distal side of the outer surface thereof and the proximal side annular rib 64 formed at the proximal side of the outer surface thereof.

[0039] As shown in Fig. 30, the gasket body 6b has the inner cavity 60 which is an accommodation part accommodating the plunger-mounting member 7b. The inner cavity 60 has the plunger-mounting member removal prevention rib 83 formed on the inner surface thereof. In this embodiment, the plunger-mounting member removal prevention rib 83 is disposed at the proximal side (in the vicinity of the opening) of the inner cavity 60. The plunger-mounting member removal prevention rib 83 is formed as an endless annular rib almost orthogonal to the axis of the gasket body 6b. Although it is preferable that the plunger-mounting member removal prevention rib 83 is formed as the annular rib, the plunger-mounting member removal prevention rib 83 may be formed as a plurality of uncontinuous ribs disposed on the same circumference. The distal end surface of the plunger-mounting member removal prevention rib 83 is formed as the annular erect surface 83a erect from the inner surface of the inner cavity 60. The proximal end surface of the plunger-mounting member removal prevention rib 83 is formed as the annular inclined surface 83b, the diameter of which increases toward the proximal end thereof. It is preferable

that the plunger-mounting member removal prevention rib 83 has the equal inner diameter portion which has the substantially equal inner diameter and is extended in the predetermined length. Because the plunger-mounting member removal prevention rib 83 has the equal inner diameter portion, it is possible to securely prevent the plunger-mounting member from separating from the gasket body when the plunger is pulled toward the proximal end thereof. The height of the plunger-mounting member removal prevention rib 83 is favorably 0.5 to 2.0mm and especially favorably 1.0 to 1.5mm. The length of the equal inner diameter portion of the plunger-mounting member removal prevention rib 83 is favorably 1.0 to 6.0mm and especially favorably 2.0 to 4.0mm.

[0040] The gasket body 6b has the projection part 66 projected from the central portion of the inner surface of the distal end portion thereof toward the proximal side thereof. The projection part 66 contacts the distal end of the tubular distal end part 42 of the plunger 4, when the distal end portion of the gasket body 6b deforms toward its proximal side, thus preventing the distal end portion of the gasket body 6b from excessively deforming. It is preferable that the projection part 66 is approximately semispherical. Generally the diameter of the gasket body 6b is 5 to 30mm, and the whole length thereof is 5 to 30mm.

As shown in Figs. 29 and 30, in this embodiment, the gasket body 6b has the plunger-mounting member contact part 69 on the inner surface of the distal end portion of the inner cavity 60. The plunger-mounting member contact part 69 is formed as the annular surface facing toward the proximal end of the gasket body 6b. As shown in Fig. 29, the distal end surface of the plunger-mounting member 7b is capable of contacting the plunger-mounting member contact part 69. The plunger-mounting member contact part 69 surrounds the projection part 66. Although it is preferable that the plunger-mounting member contact part is formed as the annular surface, the plunger-mounting member contact part may be formed as an annular rib facing the proximal side of the gasket body 6b or as a plurality of uncontinuous ribs facing the proximal side thereof.

As constituent materials of the gasket body 6b, it is possible to preferably use the above-described materials described as being preferable for the gasket body 6. The distal end of the gasket body 6b may be coated with a medical agent low adsorptive substance. As materials forming a medical agent low adsorptive layer, the above-described materials can be preferably used. A lubricant is applied to the outer surface of the gasket body 6b. It is preferable to apply the lubricant to at least the surface of the distal side annular rib 63 and that of the proximal side annular rib 64. The lubricant may be applied to the inner surface of the outer cylinder. As the lubricant, silicone oil is suitable. By forming a silicone resin layer on the surface of the gasket body by solidifying the silicone resin, it is possible to eliminate the need for the use of the lubricant such as the silicone oil.

[0041] As with the above-described plunger-mounting member 7 and as shown in Figs. 31 through 32, the plunger-mounting member 7b is a tubular body having a hollow portion penetrating therethrough from a distal end thereof to a proximal end thereof and can be accommodated inside the inner cavity 60 of the gasket body 6b. The plunger-mounting member 7b has an outer projected part 78 which is formed on an outer surface thereof and engages the plunger-mounting member removal prevention rib 83 of the gasket body 6b, thus preventing the plunger-mounting member 7b from separating from the gasket body 6b. As with the above-described plunger-mounting members 7 and 7a, the plunger-mounting member 7b has a plurality of the elastically deformable inner projected parts (only 75a, 75b, and 75f are shown) which are extended obliquely from an inner portion of a proximal side of the plunger-mounting member 7b toward a central and distal end thereof and have a free end respectively at a position which does not reach the center thereof, and a plurality of the plunger removal prevention locking parts (only 76a, 76b, and 76f are shown) formed at the free ends of the inner projected parts (only 75a, 75b, and 75f are shown) respectively. A plurality of the inner projected parts and the plunger removal prevention locking parts formed at the free ends of the inner projected parts respectively are the same as those described above.

As shown in Fig. 33, the plunger 4 has the pressing part 45 capable of pressing the proximal end portion 67 of the gasket body 6b when the plunger 4 is mounted on the gasket 3b, the tubular distal end part 42 projected from the pressing part 45 toward the distal end of the plunger 4 and is capable of penetrating into the plunger-mounting member 7b, and the outer projection part 43 which is disposed on the outer surface of the tubular distal end part 42 and engages the plunger removal prevention locking parts of the plunger-mounting member 7b. A plurality of ribs 68 is formed on the proximal end surface (proximal end portion) 67 of the gasket body 6b of this embodiment.

[0042] The outer projected part 78 engages the plunger-mounting member removal prevention rib 83 of the gasket body 6b, thus preventing the plunger-mounting member 7b from separating from the gasket body 6b. In the plunger-mounting member 7b of this embodiment, the outer projected part 78 is formed on the outer surface of the proximal end portion (specifically, position a little distal from proximal end) of the body part 71 as an annular projected part almost orthogonal to the axis of the plunger-mounting member 7b. A proximal end surface of the outer projected part (annular projected part formed on the outer surface) 78 is formed as an annular erect surface erect from the outer surface of the body part 71. The outer projected part 78 is not limited to the annular configuration, but may be constructed of a plurality of uncontinuous projected parts. The height of the outer projected part 78 is favorably 0.5 to 2.0mm and especially favorably 1.0 to 1.5mm. The outer diameter of the plunger-mount-

ing member 7b at the outer projected part 78 thereof is larger than the inner diameter of the plunger-mounting member removal prevention rib 83 of the gasket body 6b by 1.0 to 4.0mm and more favorably by 2.0 to 3.0mm. The gasket body 6b has an annular part 79 projected proximally from the outer projected part 78. The outer surface of the annular part 79 is formed as an annular inclined surface, the diameter of which decreases toward the proximal end thereof.

[0043] The plunger-mounting member 7b is mounted on the gasket body 6b in a state in which the plunger-mounting member removal prevention rib 83 of the gasket body 6b and the outer projected part 78 of the plunger-mounting member 7b have engaged each other. In the gasket 3b of this embodiment, the plunger-mounting member 7b is a little movable inside the gasket body 6b. But in the gasket 3b of the type of this embodiment, the proximal end surface of the outer projected part 78 of the plunger-mounting member 7b may contact the distal end surface of the plunger-mounting member removal prevention rib 83, and the distal end surface of the distal end portion of the plunger-mounting member 7b may contact the plunger-mounting member contact part 69 of the gasket body 6b. That is, the plunger-mounting member 7b may be held by the plunger-mounting member contact part 69 of the gasket body 6b and the plunger-mounting member removal prevention rib 83 and prevented from moving inside the gasket body 6b. The proximal end of the plunger-mounting member 7b mounted on the gasket body 6b does not project beyond the gasket body 6b. In other words, in a state in which the plunger-mounting member 7b is mounted on the gasket body 6b, the proximal end of the plunger-mounting member 7b is located at a position distal from the proximal end of the gasket body by a predetermined length. As shown in Fig. 33, in a syringe using the gasket 3b of this embodiment, when the plunger 4 is mounted on the gasket 3b, the distal end of the tubular distal end part 42 of the plunger 4 does not contact the inner surface of the gasket body 6b.

As the constituent material for the plunger-mounting member 7b, it is possible to preferably use the above-described ones.

[0044] The gasket is not limited to the above-described gasket 3, but it is possible to use a gasket 3c as shown in Figs. 34 through 39 for the prefilled syringe of the present invention.

Fig. 34 is an enlarged front view of a gasket for use in a prefilled syringe of another embodiment of the present invention. Fig. 35 is a sectional view taken along a line I-I of Fig. 34. Fig. 36 is a vertical sectional view of a gasket body for use in the gasket shown in Fig. 34. Fig. 37 is a front view of a gasket-mounting member for use in the gasket shown in Fig. 34. Fig. 38 is a sectional view taken along a line J-J of Fig. 37. Fig. 39 is an explanatory view for explaining an operation of mounting the plunger on the body of the prefilled syringe of the present invention in which the gasket shown in Fig. 34 is used.

[0045] The fundamental construction of the gasket 3c

is the same as the above-described gasket 3.

The gasket 3c is a tubular body whose distal end is closed and proximal end is open and composed of a gasket body 6c which has the inner cavity 60 extended from the opening formed at the proximal end thereof to the distal end thereof and a plunger-mounting member 7c mounted on the gasket body 6c.

The gasket body 6c has the plunger-mounting member removal prevention rib 83 formed on the inner surface of the inner cavity 60.

As shown in Figs. 34 through 36, the gasket body 6c is the tubular body having the closed distal end and the inner cavity 60 extended from the opening formed at the proximal end of the gasket body 6c toward the distal end thereof. The gasket body 6c has the tapered part 61, the diameter of which taperingly decreases toward the distal end thereof. The gasket body 6c has the distal side annular rib 63 formed at the distal side of the outer surface thereof and the proximal side annular rib 64 formed at the proximal side of the outer surface thereof.

[0046] As shown in Fig. 36, the gasket body 6c has the inner cavity 60 which is an accommodation part accommodating the plunger-mounting member 7c. The inner cavity 60 has the plunger-mounting member removal prevention rib 62 formed on the inner surface thereof. In this embodiment, the plunger-mounting member removal prevention rib 62 is disposed at the distal side of the inner cavity 60. The plunger-mounting member removal prevention rib 62 is formed as an endless annular rib almost orthogonal to the axis of the gasket body 6c. Although it is preferable that the plunger-mounting member removal prevention rib 62 is formed as the annular rib, the plunger-mounting member removal prevention rib 62 may be formed as a plurality of uncontinuous ribs disposed on the same circumference. The distal end surface of the plunger-mounting member removal prevention rib 62 is formed as an annular inclined surface 62a, the diameter of which increases toward the distal end thereof. It is preferable that the plunger-mounting member removal prevention rib 62 has the equal inner diameter portion which has the substantially equal inner diameter and is extended in the predetermined length. Because the plunger-mounting member removal prevention rib 62 has the equal inner diameter portion, it is possible to securely prevent the plunger-mounting member from separating from the gasket body, when the plunger is pulled toward the proximal end thereof. The height of the plunger-mounting member removal prevention rib 62 is favorably 0.5 to 2.0mm and especially favorably 1.0 to 1.5mm. The length of the equal inner diameter portion of the plunger-mounting member removal prevention rib 62 is favorably 1.0 to 6.0mm and especially favorably 2.0 to 4.0mm.

The gasket 6c of this embodiment has a rib 84 disposed at the proximal side (in the vicinity of the opening) of the inner cavity 60. The rib 84 is formed as an endless annular rib almost orthogonal to the axis of the gasket body 6c. Although it is preferable that the rib 84 is formed as the annular rib, the rib 84 may be formed as a plurality of

uncontinuous ribs disposed on the same circumference.

[0047] The gasket body 6c has the projection part 66 projected from the central portion of the inner surface of the distal end portion thereof toward the proximal side thereof. The projection part 66 contacts the distal end of the tubular distal end part 42 of the plunger 4, when the distal end portion of the gasket body 6c deforms toward its proximal side, thus preventing the distal end portion of the gasket body 6c from excessively deforming. It is preferable that the projection part 66 is approximately semispherical. Generally the diameter of the gasket body 6c is 5 to 30mm, and the whole length thereof is 5 to 30mm.

As shown in Figs. 35 and 36, in this embodiment, the gasket body 6c has the plunger-mounting member contact part 69 on the inner surface of the distal end portion of the inner cavity 60. The plunger-mounting member contact part 69 is formed as an annular surface facing toward the proximal end of the gasket body 6c. As shown in Fig. 35, the distal end surface of the plunger-mounting member 7c is capable of contacting the plunger-mounting member contact part 69. The plunger-mounting member contact part 69 surrounds the projection part 66. Although it is preferable that the plunger-mounting member contact part is formed as the annular surface, the plunger-mounting member contact part may be formed as an annular rib facing the proximal side of the gasket body 6c or as a plurality of the uncontinuous ribs facing the proximal side thereof.

As constituent materials of the gasket body 6c, it is possible to preferably use the above-described materials described as being preferable for the gasket body 6. The distal end of the gasket body 6c may be coated with a medical agent low adsorptive substance. As materials forming a medical agent low adsorptive layer, the above-described materials can be preferably used. A lubricant is applied to the outer surface of the gasket body 6c. It is preferable to apply the lubricant to at least the surface of the distal side annular rib 63 and that of the proximal side annular rib 64. The lubricant may be applied to the inner surface of the outer cylinder. As the lubricant, silicone oil is suitable. By forming the silicone resin layer on the surface of the gasket body by solidifying the silicone resin, it is possible to eliminate the need for the use of the lubricant such as the silicone oil.

[0048] As with the above-described plunger-mounting member 7 and as shown in Figs. 37 through 38, the plunger-mounting member 7c is a tubular body having a hollow portion penetrating therethrough from a distal end thereof to a proximal end thereof and can be accommodated inside the inner cavity 60 of the gasket body 6c. The plunger-mounting member 7c has an outer projected part 85 which is formed on an outer surface thereof and engages the plunger-mounting member removal prevention rib 62 of the gasket body 6c, thus preventing the plunger-mounting member 7c from separating from the gasket body 6c. As with the above-described plunger-mounting members 7 and 7a, the plunger-mounting

member 7c has a plurality of the elastically deformable inner projected parts (only 75a, 75b, and 75f are shown) which are extended obliquely from an inner portion of a proximal side of the plunger-mounting member 7c toward a central and distal end thereof and have a free end respectively at a position which does not reach the center thereof, and the plunger removal prevention locking parts (only 76a, 76b, and 76f are shown) formed at the free ends of the inner projected parts (only 75a, 75b, and 75f are shown) respectively. A plurality of the inner projected parts and the plunger removal prevention locking parts formed at the free ends of the inner projected parts respectively are the same as those described above.

As shown in Fig. 39, the plunger 4 has the pressing part 45 capable of pressing the proximal end portion 67 of the gasket body 6c when the plunger 4 is mounted on the gasket 3c, the tubular distal end part 42 projected from the pressing part 45 toward the distal end of the plunger 4 and being capable of penetrating into the plunger-mounting member 7c, and the outer projection part 43 which is disposed on the outer surface of the tubular distal end part 42 and engages the plunger removal prevention locking parts of the plunger-mounting member 7c. A plurality of the ribs 68 is formed on the proximal end surface (proximal end portion) 67 of the gasket body 6c of this embodiment.

[0049] The outer projected part 85 engages the plunger-mounting member removal prevention rib 62 of the gasket body 6c, thus preventing the plunger-mounting member 7c from separating from the gasket body 6c. In the plunger-mounting member 7c of this embodiment, the outer projected part 85 is formed on the outer surface of the distal end portion (specifically, outer surface of distal end) of the body part 71 as an annular projected part almost orthogonal to the axis of the plunger-mounting member 7c. The outer projected part 85 is not limited to the annular configuration, but may be constructed of a plurality of uncontinuous projected parts. The height of the outer projected part 85 is favorably 0.5 to 2.0mm and especially favorably 1.0 to 1.5mm. The outer diameter of the plunger-mounting member 7c at the outer projected part 85 thereof is larger than the inner diameter of the plunger-mounting member removal prevention rib 62 of the gasket body 6c by 1.0 to 4.0mm and more favorably by 2.0 to 3.0mm.

[0050] The plunger-mounting member 7c is mounted on the gasket body 6c in a state in which the plunger-mounting member removal prevention rib 62 of the gasket body 6c and the outer projected part 85 of the plunger-mounting member 7c have engaged each other. In the gasket 3c of this embodiment, the plunger-mounting member 7c is a little movable inside the gasket body 6c. But the proximal end surface of the outer projected part 85 of the plunger-mounting member 7c may contact the distal end surface of the plunger-mounting member removal prevention rib 62, and the distal end surface of the distal end portion of the plunger-mounting member 7c may contact the plunger-mounting member contact part

69 of the gasket body 6c. That is, the plunger-mounting member 7b may be held by the plunger-mounting member contact part 69 of the gasket body 6c and the plunger-mounting member removal prevention rib 83 and prevented from moving inside the gasket body 6c. The proximal end of the plunger-mounting member 7c mounted on the gasket body 6c does not project beyond the gasket body 6c. In other words, in a state in which the plunger-mounting member 7c is mounted on the gasket body 6c, the proximal end of the plunger-mounting member 7c is located at a position distal from the proximal end of the gasket body by a predetermined length. As shown in Fig. 39, in a syringe using the gasket 3c of this embodiment, when the plunger 4 is mounted on the gasket 3c, the distal end of the tubular distal end part 42 of the plunger 4 does not contact the inner surface of the gasket body 6. As the constituent material for the plunger-mounting member 7c, it is possible to preferably use the above-described ones.

[0051] The gasket is not limited to the above-described gasket 3, but it is possible to use a gasket 3d as shown in Figs. 40 through 45 for the prefilled syringe of the present invention.

Fig. 40 is an enlarged front view of a gasket for use in a prefilled syringe of another embodiment of the present invention. Fig. 41 is a sectional view taken along a line K-K of Fig. 40. Fig. 42 is a vertical sectional view of a gasket body for use in the gasket shown in Fig. 40. Fig. 43 is a front view of a gasket-mounting member for use in the gasket shown in Fig. 40. Fig. 44 is a sectional view taken along a line L-L of Fig. 43. Fig. 45 is an explanatory view for explaining an operation of mounting the plunger on the body of the prefilled syringe of the present invention in which the gasket shown in Fig. 40 is used.

[0052] The fundamental construction of the gasket 3d is the same as the above-described gasket 3a. The plunger-mounting member to be mounted on the gasket 3d is different from that to be mounted on the gasket 3a. Because the construction of a gasket body 6d is the same as that of the gasket body 6a, reference is made to the above-described description.

As with the gasket body 6a and as shown in Figs. 41 and 42, the gasket body 6d has the inner cavity 60 which is an accommodation part accommodating the plunger-mounting member 7d. The inner cavity 60 has the plunger-mounting member removal prevention rib 83 and the plunger-mounting member movement prevention rib 82 both formed on the inner surface thereof. In this embodiment, the plunger-mounting member removal prevention rib 83 is disposed at the proximal side (in the vicinity of the opening) of the inner cavity 60, and the plunger-mounting member movement prevention rib 82 is located at a position a little distal from the plunger-mounting member removal prevention rib 83. In this embodiment, as shown in Figs. 41 and 42, the gasket body 6d has the annular concave portion formed between the plunger-mounting member removal prevention rib 83 and the plunger-mounting member movement prevention rib 82.

The annular concave portion is capable of accommodating an outer projected part 88 of the plunger-mounting member 7d.

[0053] As with the above-described plunger-mounting member 7 and as shown in Figs. 43 through 44, the plunger-mounting member 7d is a tubular body having a hollow portion penetrating therethrough from a distal end thereof to a proximal end thereof and can be accommodated inside the inner cavity 60 of the gasket body 6d. The plunger-mounting member 7d has the outer projected part 88 which is formed on an outer surface thereof and engages the plunger-mounting member removal prevention rib 83 of the gasket body 6d, thus preventing the plunger-mounting member 7d from separating from the gasket body 6d. As with the above-described plunger-mounting members 7 and 7a, the plunger-mounting member 7d has a plurality of the elastically deformable inner projected parts (only 75a, 75b, and 75f are shown) which are extended obliquely from an inner portion of a proximal side of the plunger-mounting member 7d toward a central and distal end thereof and have a free end respectively at a position which does not reach the center thereof, and a plurality of the plunger removal prevention locking parts (only 76a, 76b, and 76f are shown) formed at the free ends of the inner projected parts (only 75a, 75b, and 75f are shown) respectively. A plurality of the inner projected parts and the plunger removal prevention locking parts formed at the free ends of the inner projected parts respectively are the same as those described above.

As shown in Fig. 45, the plunger 4 has the pressing part 45 capable of pressing the proximal end portion 67 of the gasket body 6d when the plunger 4 is mounted on the gasket 3d, the tubular distal end part 42 projected from the pressing part 45 toward the distal end of the plunger 4 and is capable of penetrating into the plunger-mounting member 7d, and the outer projection part 43 which is disposed on the outer surface of the tubular distal end part 42 and engages the plunger removal prevention locking parts of the plunger-mounting member 7d. A plurality of the ribs 68 is formed on the proximal end surface (proximal end portion) 67 of the gasket body 6d of this embodiment.

[0054] The outer projected part 88 engages the plunger-mounting member removal prevention rib 83 of the gasket body 6d, thus preventing the plunger-mounting member 7d from separating from the gasket body 6d. In the plunger-mounting member 7d of this embodiment, the outer projected part 88 is formed on the outer surface of the proximal end portion (specifically, outer surface of proximal end) of the body part 71 as an annular projected part almost orthogonal to the axis of the plunger-mounting member 7d. The proximal end surface of the outer projected part (annular projected part formed on the outer surface) 88 is formed as an annular erect surface erect from the outer surface of the body part 71. The outer projected part 88 is not limited to the annular configuration, but may be constructed of a plurality of uncontinuous

projected parts. The height of the outer projected part 88 is favorably 0.5 to 2.0mm and especially favorably 1.0 to 1.5mm. The outer diameter of the plunger-mounting member 7d at the outer projected part 88 thereof is larger than the inner diameter of the plunger-mounting member removal prevention rib 83 of the gasket body 6b by 1.0 to 4.0mm and more favorably by 2.0 to 3.0mm.

The plunger-mounting member 7d has a second outer projected part 87 formed at a position a little distal from the outer projected part 88. The second outer projected part 87 engages the plunger-mounting member removal prevention rib 82, thus preventing the plunger-mounting member 7d from moving toward the proximal end thereof. The second outer projected part 87 of the plunger-mounting member 7d is formed as an annular projected part almost orthogonal to the axis of the plunger-mounting member 7d. The proximal end surface of the outer projected part 87 is formed as an annular erect surface erect from the outer surface of the body part 71. The outer projected part 87 is not limited to the annular configuration, but may be constructed of a plurality of uncontinuous projected parts. The height of the outer projected part 87 is favorably 0.5 to 2.0mm and especially favorably 1.0 to 1.5mm. The outer diameter of the plunger-mounting member 7d at the outer projected part 88 thereof is larger than the inner diameter of the plunger-mounting member removal prevention rib 82 of the gasket body 6d by 1.0 to 4.0mm and more favorably by 2.0 to 3.0mm.

[0055] The plunger-mounting member 7d is mounted on the gasket body 6d in a state in which the plunger-mounting member removal prevention rib 83 of the gasket body 6d and the outer projected part 77 of the plunger-mounting member 7d have engaged each other. In the gasket 3d of this embodiment, the plunger-mounting member 7d is a little movable inside the gasket body 6d. But in the gasket 3d of the type of this embodiment, the proximal end surface of the outer projected part 88 of the plunger-mounting member 7d may contact the distal end surface of the plunger-mounting member removal prevention rib 83, and the distal end surface of the distal end portion of the plunger-mounting member 7d may contact the plunger-mounting member contact part 69 of the gasket body 6d. That is, the plunger-mounting member 7d may be held by the plunger-mounting member contact part 69 of the gasket body 6d and the plunger-mounting member removal prevention rib 83 and prevented from moving inside the gasket body 6d. The proximal end of the plunger-mounting member 7d mounted on the gasket body 6d does not project beyond the gasket body 6d. In other words, in a state in which the plunger-mounting member 7d is mounted on the gasket body 6d, the proximal end of the plunger-mounting member 7d is located at a position distal from the proximal end of the gasket body by a predetermined length. As shown in Fig. 45, in a syringe using the gasket of this embodiment, when the plunger 4 is mounted on the gasket 3d, the distal end of the tubular distal end part 42 of the plunger 4 does not contact the inner surface of the gasket body 6d.

As the constituent material for the plunger-mounting member 7d, it is possible to preferably use the above-described ones.

[0056] The plunger is not limited to the above-described plunger 4, but it is possible to use a plunger 4a as shown in Figs. 46 through 50 for the prefilled syringe of the present invention.

Fig. 46 is an enlarged front view of a plunger for use in a prefilled syringe of another embodiment of the present invention. Fig. 47 is a perspective view of the plunger shown in Fig. 46. Fig. 48 is an enlarged view of the neighborhood of a distal end portion of the plunger shown in Fig. 46. Fig. 49 is an enlarged vertical sectional view of the neighborhood of the distal end portion of the plunger shown in Fig. 46. Fig. 50 is an explanatory view for explaining an operation of mounting the plunger on the body of the prefilled syringe of the present invention in which the plunger shown in Fig. 46 is used.

The plunger 4a is different from the above-described plunger 4 in that the former has an annular concave portion 49 formed at the distal end portion 42 thereof. The plunger 4a of this embodiment has the concave portion formed at the proximal side of the outer projection part 43 formed on the distal end portion 42. The distal end portions of the inner projected parts of the plunger-mounting member 7 are capable of entering the concave portion. The concave portion is annular.

As shown in Figs. 46 through 50 and as with the plunger 4, the plunger 4a has the body part 41, the pressing part 45 capable of pressing the proximal end surface of the gasket 3 when the plunger 4a is mounted on the gasket 3, the tubular distal end part 42 projected from the pressing part 45 toward the distal end of the plunger 4 and is capable of penetrating into the hollow portion of the plunger-mounting member 7, and the outer projection part 43 which is disposed on the outer surface of the tubular distal end part 42 and engages the plunger removal prevention locking parts (only 76b and 76f are shown) of the plunger-mounting member 7. The plunger 4a has the annular concave portion 49 which is close and back side to the outer projection part 43. The removal prevention parts (only 76b and 76f are shown) are capable of entering into the annular concave portion 49. As shown in Figs. 48 and 49, the annular concave portion 49 has a tapered portion which is formed at the proximal end portion thereof and the diameter of which decreases toward the outer projection part 43. It is preferable that the depth (depth at the deepest portion) of the annular concave portion 49 is 0.5 to 3mm.

[0057] The plunger 4a can be mounted on the plunger-mounting member 7 by pressing the distal end part 42 into the hollow portion of the plunger-mounting member 7. As shown in Fig. 50, the distal end part 42 of the plunger 4a does not contact the inner surface of the gasket body 6, when the plunger 4a is mounted on the gasket 3.

In the plunger 4a of this embodiment, the outer projection part 43 is formed on the outer surface of the distal end portion (specifically, outer surface of distal end) of the

tubular distal end part 42 as the annular outer projection part almost orthogonal to the axis of the tubular distal end part 42 of the plunger 4. The proximal end surface of the outer projection part (annular projection part formed on outer surface) 43 is formed as the annular erect surface erect from the outer surface of the tubular distal end part 42. The outer projection part 43 is not limited to the annular configuration, but may consist of a plurality of the uncontinuous projections. The height of the outer projection part 43 is favorably 0.3 to 1.5mm and especially favorably 0.5 to 1.0mm. The outer diameter of the plunger 4a at the outer projection part 43 thereof is larger than the diameter of a circle formed of the inner surfaces of the free ends of the inner projected parts (only 75b and 75f are shown) of the plunger-mounting member 7 by 0.5 to 3.0mm and more favorably by 1.0 to 2.0mm.

[0058] By pressing the tubular distal end part 42 of the plunger 4a including the outer projection part 43 into the hollow portion of the plunger-mounting member 7, the outer projection part 43 presses and elastically deforms the inner projected parts (only 75b and 75f are shown) of the plunger-mounting member 7 and passes through the inner projected parts (only 75b and 75f are shown). Thereafter the inner projected parts (only 75b and 75f are shown) are restored to the original configuration thereof or to an almost original configuration thereof. Thereby the plunger removal prevention locking parts (only 75b and 75f are shown) enter into the annular concave portion 49 and engage the proximal end surface of the outer projection part 43. Thereby the plunger 4a is prevented from separating from the plunger-mounting member 7.

In the plunger 4a of this embodiment, in a state in which the plunger 4a is mounted on the plunger-mounting member 7, the inner surface of the free end of each of the inner projected parts (only 75b and 75f are shown) is in contact with the outer surface of the annular concave portion 49 of the tubular distal end part 42 of the plunger 4a. As shown in Fig. 50, in the state in which the plunger 4a is mounted on the plunger-mounting member 7, the inner surface of the free end of each of the inner projected parts (only 75b and 75f are shown) contacts the outer surface of the annular concave portion 49 of the tubular distal end part 42 of the plunger 4a. In the state in which the plunger 4a is mounted on the plunger-mounting member 7, as shown in Fig. 50, the inner surface of the free end of each of the inner projected parts (only 75b and 75f are shown) contacts the outer surface (outer surface of the annular concave part 49) of the tubular distal end part 42 of the plunger 4a under pressure with the free ends of the inner projected parts being pressed a little in a direction in which the free ends expand a little.

INDUSTRIAL APPLICABILITY

[0059] The prefilled syringe of the present invention is as described below. (1) A prefilled syringe comprising a prefilled syringe body having an outer cylinder, a gasket

slidably accommodated inside said outer cylinder, a sealing member which seals an opening formed at a distal end of said outer cylinder, and a medical agent accommodated inside a medical agent accommodation part formed inside said outer cylinder; and a plunger which is mounted on said gasket or mountable thereon; wherein said gasket is composed of a gasket body which is a tubular body whose distal end is closed and proximal end is open and which has an inner cavity extended from an opening formed at said proximal end thereof to said distal end thereof and a plunger-mounting member mounted on said gasket body; said gasket body has a plunger-mounting member removal prevention rib formed on an inner surface of said inner cavity; said plunger-mounting member formed as a tubular body which has a hollow portion penetrating therethrough from a distal end thereof to a proximal end thereof and can be accommodated inside said inner cavity of said gasket body, comprising an outer projected part formed on an outer surface thereof and engaging a plunger-mounting member removal prevention rib of said gasket body, thus preventing said plunger-mounting member from separating from said gasket body; a plurality of elastically deformable inner projected parts which are extended obliquely from an inner portion of a proximal side of said plunger-mounting member toward a central and distal end thereof and have a free end respectively at a position which does not reach a center thereof; and plunger removal prevention locking parts formed at said free ends of said inner projected parts respectively; said plunger has a pressing part capable of pressing a proximal end portion of said gasket body in an operation of mounting said plunger on said gasket; a distal end part projected from said pressing part toward said distal end thereof and capable of entering said plunger-mounting member; and an outer projection part disposed on an outer surface of said distal end part and engaging said plunger removal prevention locking parts of said plunger-mounting member; and said plunger-mounting member is mounted on said gasket body in a state in which said plunger-mounting member removal prevention rib of said gasket body and said outer projected part of said plunger-mounting member have engaged each other; and when said plunger is mounted on said gasket, said distal end part of said plunger does not contact an inner surface of said gasket body.

[0060] The embodiments of the present invention may be as described below.

(2) A prefilled syringe according to any one of the above (1), wherein each of said inner projected parts of said plunger-mounting member becomes smaller toward said free end thereof in a width thereof.

(3) A prefilled syringe according to any one of the above (1) or (2), wherein distal end surfaces of said free ends of said inner projected parts of said plunger-mounting member are formed as flat surfaces respectively almost orthogonal to an axis of said plunger-mounting member; said plunger removal preven-

tion locking parts are formed on said distal end surfaces of said free ends respectively; and a proximal end surface of said outer projection part of said plunger is formed as a flat surface almost orthogonal to an axis of said distal end part of said plunger.

(4) A prefilled syringe according to any one of the above (1) through (3), wherein a plurality of said inner projected parts are formed almost equiangularly with respect to said axis of said plunger-mounting member; and a number of said inner projected parts to be formed is not less than two.

(5) A prefilled syringe according to the above (1) through (4), wherein when each of said inner projected parts of said plunger-mounting member is pressed toward a proximal end thereof, said free end of each of said inner projected parts deforms in a direction in which said free end becomes close to said center of said plunger-mounting member.

(6) A prefilled syringe according to any one of the above (1) through (5), wherein an inner surface of said free end of each of said inner projected parts of said plunger-mounting member is in contact with an outer surface of said distal end part of said plunger mounted on said gasket.

(7) A prefilled syringe according to any one of the above (1) through (6), wherein other end of said plunger-mounting member does not project beyond said gasket body.

(8) A prefilled syringe according to the above (1) through (7), wherein proximal end surfaces of a plurality of said inner projected parts of said plunger-mounting member are formed as flat and smooth inclined surfaces inclined toward said center of said plunger-mounting member to form a guide portion for guiding engagement between an engaging part of said plunger and said locking parts of said plunger-mounting member.

(9) A prefilled syringe according to any one of the above (1) through (8), wherein said distal end part of said plunger capable of penetrating into said plunger-mounting member is tubular.

(10) A prefilled syringe according to any one of the above (1) through (9), wherein said plunger has a concave portion, formed at a proximal side of said outer projection part, into which distal end portions of said inner projected parts of said plunger-mounting member are capable of entering.

Claims

1. A prefilled syringe comprising a prefilled syringe body having an outer cylinder, a gasket slidably accommodated inside said outer cylinder, a sealing member which seals an opening formed at a distal end of said outer cylinder, and a medical agent accommodated inside a medical agent accommodation part formed inside said outer cylinder; and a

plunger which is mounted on said gasket or mountable thereon;

wherein said gasket is composed of a gasket body which is a tubular body whose distal end is closed and proximal end is open and which has an inner cavity extended from an opening formed at said proximal end thereof to said distal end thereof and a plunger-mounting member mounted on said gasket body;

said gasket body has a plunger-mounting member removal prevention rib formed on an inner surface of said inner cavity;

said plunger-mounting member formed as a tubular body which has a hollow portion penetrating there-through from a distal end thereof to a proximal end thereof and can be accommodated inside said inner cavity of said gasket body, comprising an outer projected part formed on an outer surface thereof and engaging a plunger-mounting member removal prevention rib of said gasket body, thus preventing said plunger-mounting member from separating from said gasket body; a plurality of elastically deformable inner projected parts which are extended obliquely from an inner portion of a proximal side of said plunger-mounting member toward a central and distal end thereof and have a free end respectively at a position which does not reach a center thereof; and plunger removal prevention locking parts formed at said free ends of said inner projected parts respectively;

said plunger has a pressing part capable of pressing a proximal end portion of said gasket body in an operation of mounting said plunger on said gasket; a distal end part projected from said pressing part toward said distal end thereof and capable of entering said plunger-mounting member; and an outer projection part disposed on an outer surface of said distal end part and engaging said plunger removal prevention locking parts of said plunger-mounting member; and

said plunger-mounting member is mounted on said gasket body in a state in which said plunger-mounting member removal prevention rib of said gasket body and said outer projected part of said plunger-mounting member have engaged each other; and when said plunger is mounted on said gasket, said distal end part of said plunger does not contact an inner surface of said gasket body.

2. A prefilled syringe according to claim 1, wherein proximal end surfaces of a plurality of said inner projected parts of said plunger-mounting member are formed as flat and smooth inclined surfaces inclined toward said center of said plunger-mounting member to form a guide portion for guiding engagement between an engaging part of said plunger and said locking parts of said plunger-mounting member.
3. A prefilled syringe according to claim 1 or 2, wherein

when each of said inner projected parts of said plunger-mounting member is pressed toward a proximal end thereof, said free end of each of said inner projected parts deforms in a direction in which said free end becomes close to said center of said plunger-mounting member.

4. A prefilled syringe according to any one of claims 1 through 3, wherein each of said inner projected parts of said plunger-mounting member becomes smaller toward said free end thereof in a width thereof.

5. A prefilled syringe according to any one of claims 1 through 4, wherein distal end surfaces of said free ends of said inner projected parts of said plunger-mounting member are formed as flat surfaces respectively almost orthogonal to an axis of said plunger-mounting member; said plunger removal prevention locking parts are formed on said distal end surfaces of said free ends respectively; and a proximal end surface of said outer projection part of said plunger is formed as a flat surface almost orthogonal to an axis of said distal end part of said plunger.

6. A prefilled syringe according to any one of claims 1 through 5, wherein a plurality of said inner projected parts are formed almost equiangularly with respect to said axis of said plunger-mounting member; and a number of said inner projected parts to be formed is not less than two.

7. A prefilled syringe according to any one of claims 1 through 6, wherein an inner surface of said free end of each of said inner projected parts of said plunger-mounting member is in contact with an outer surface of said distal end part of said plunger mounted on said gasket.

8. A prefilled syringe according to any one of claims 1 through 7, wherein other end of said plunger-mounting member does not project beyond said gasket body.

9. A prefilled syringe according to any one of claims 1 through 8, wherein said distal end part of said plunger capable of penetrating into said plunger-mounting member is tubular.

10. A prefilled syringe according to any one of claims 1 through 9, wherein said plunger has a concave portion, formed at a proximal side of said outer projection part, into which distal end portions of said inner projected parts of said plunger-mounting member are capable of entering.

Fig.1

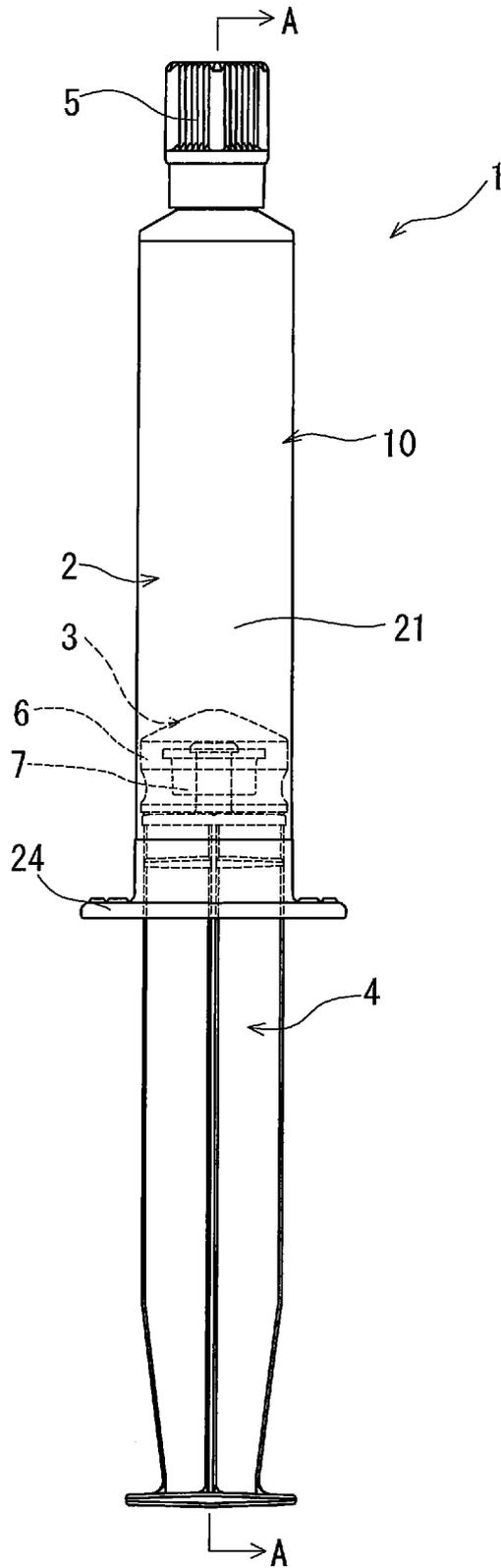


Fig.2

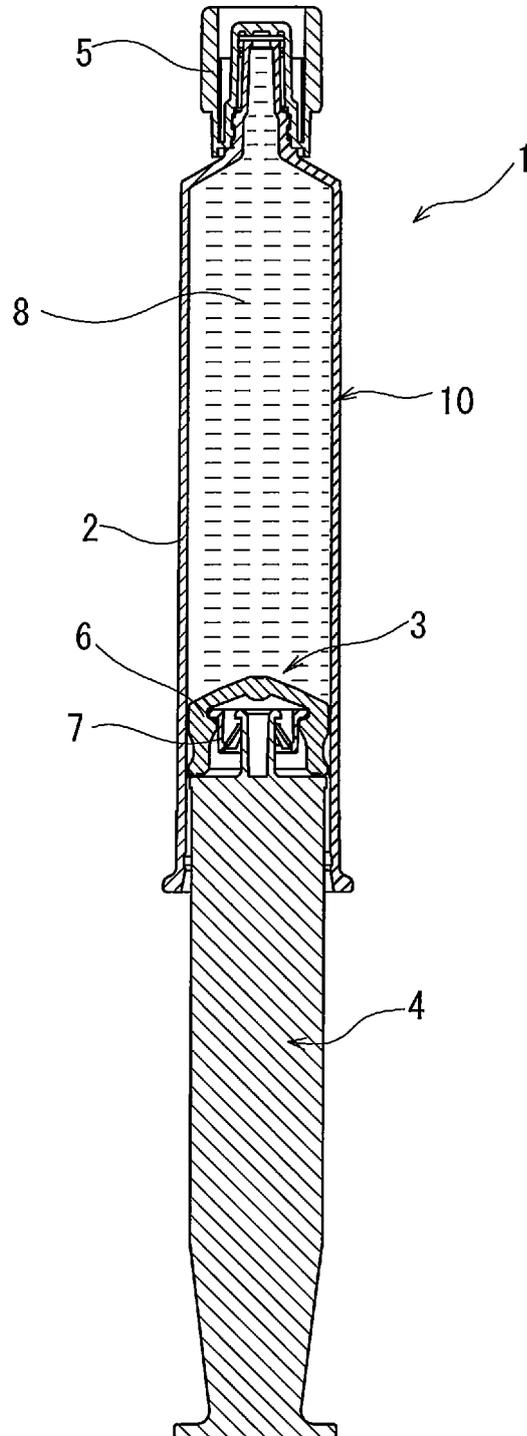


Fig.3

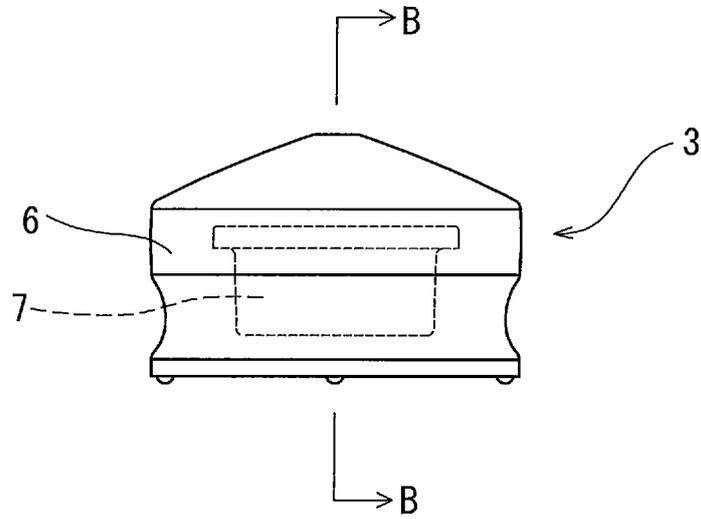


Fig.4

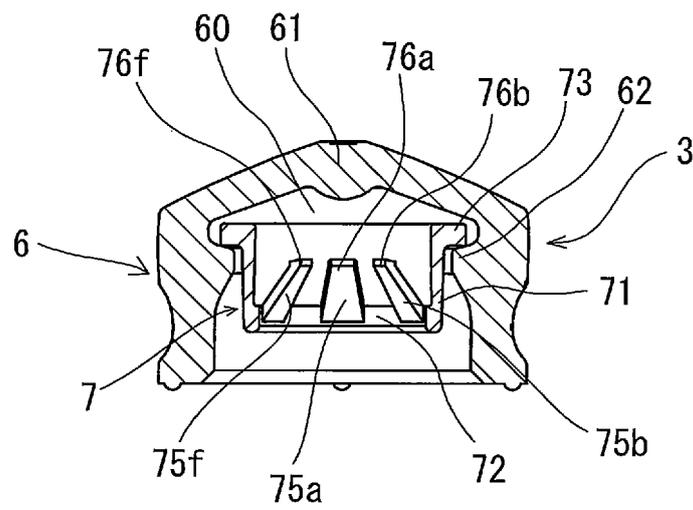


Fig.5

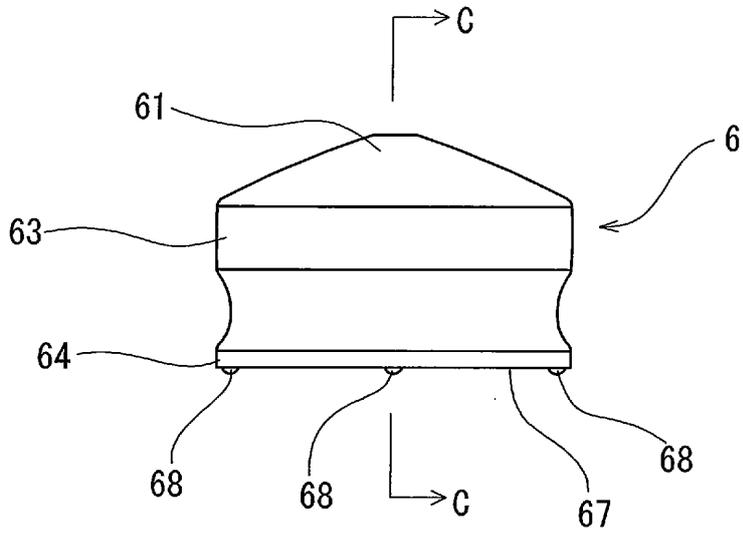


Fig.6

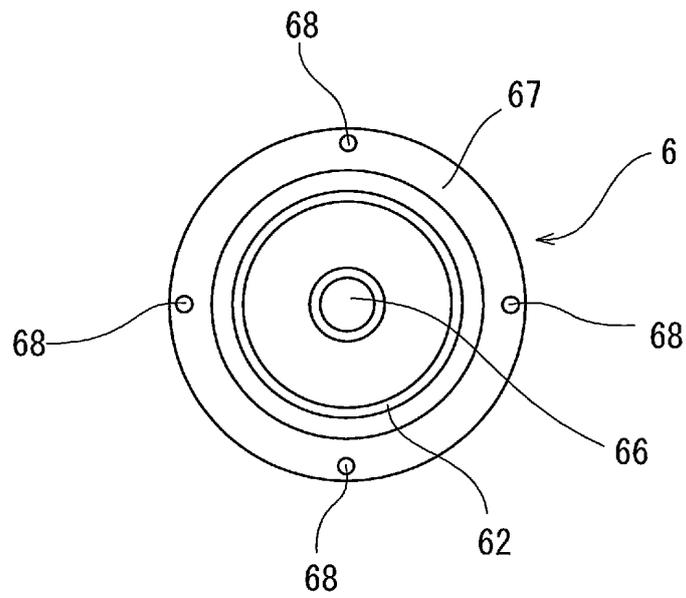


Fig.7

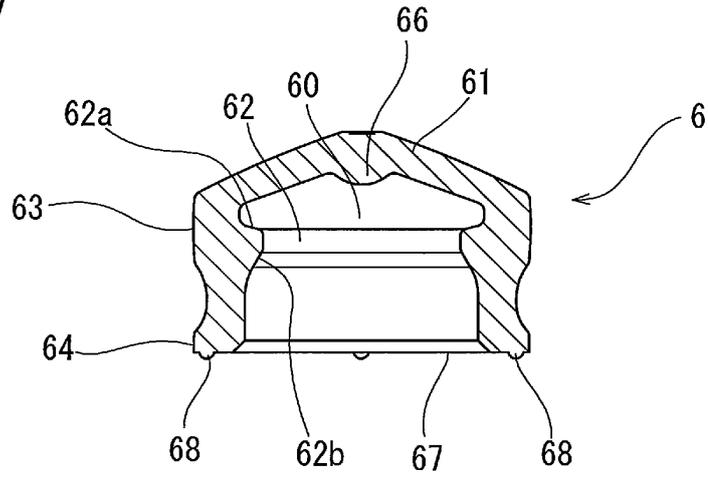


Fig.8

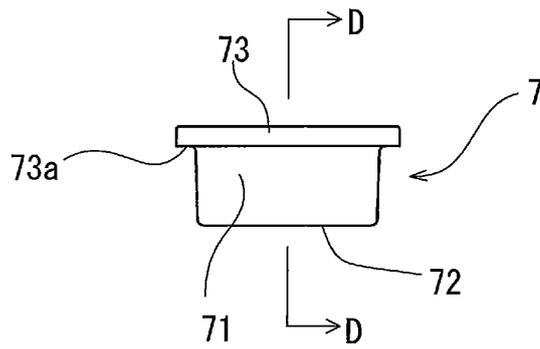


Fig.9

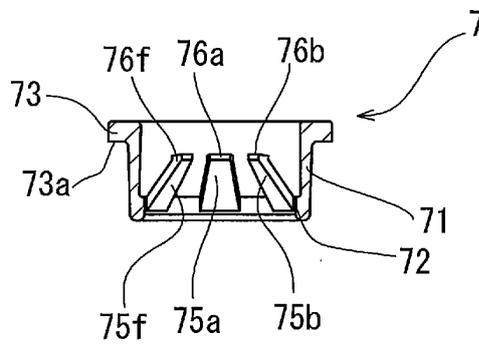


Fig.10

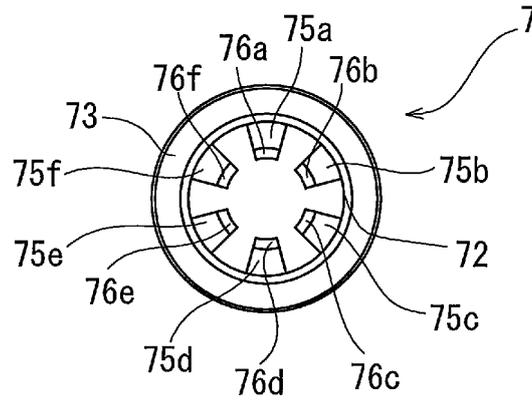


Fig.11

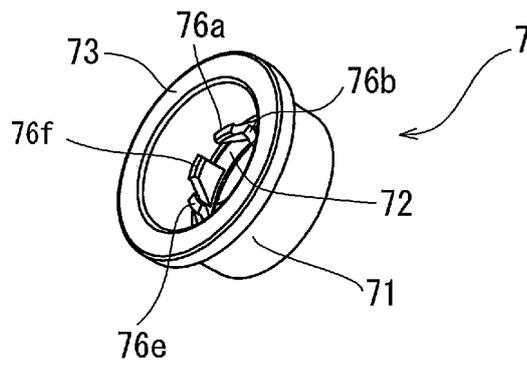


Fig.12

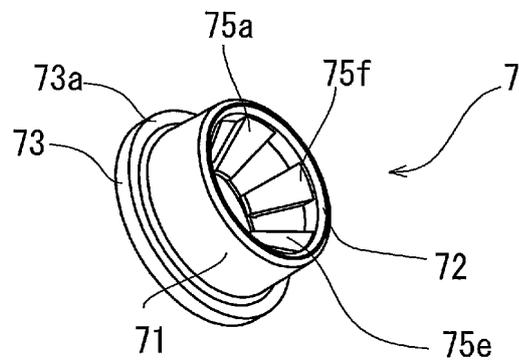


Fig.13

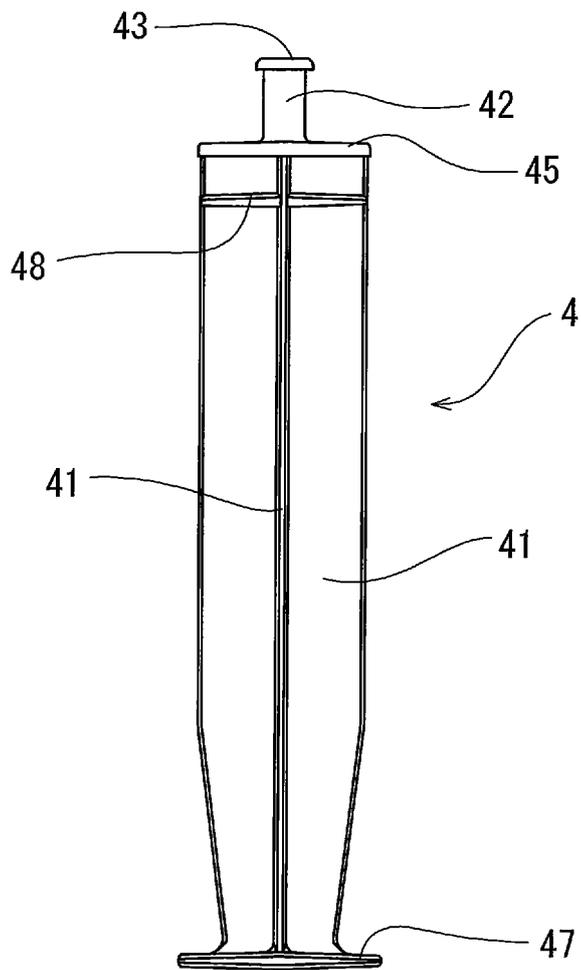


Fig.14

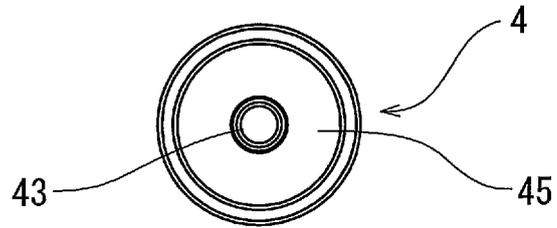


Fig.15

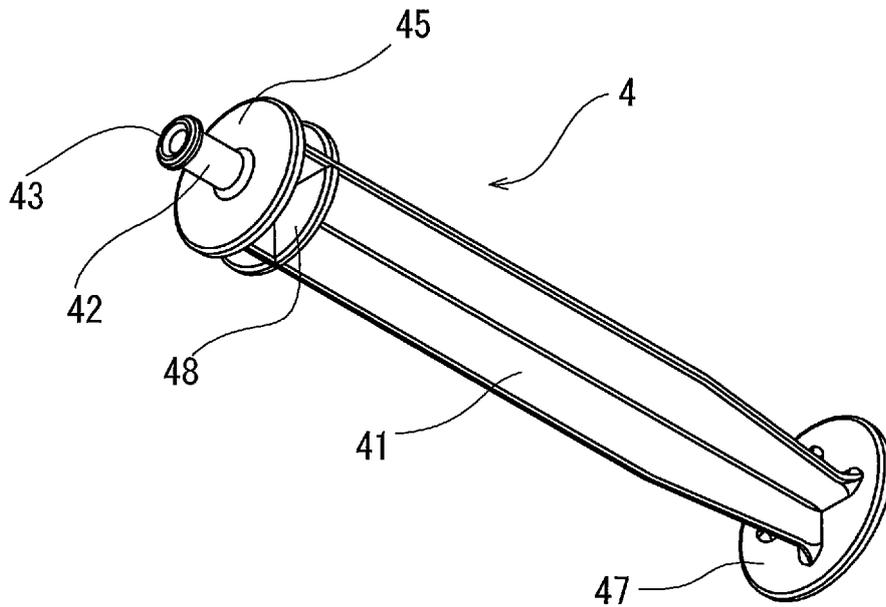


Fig.16

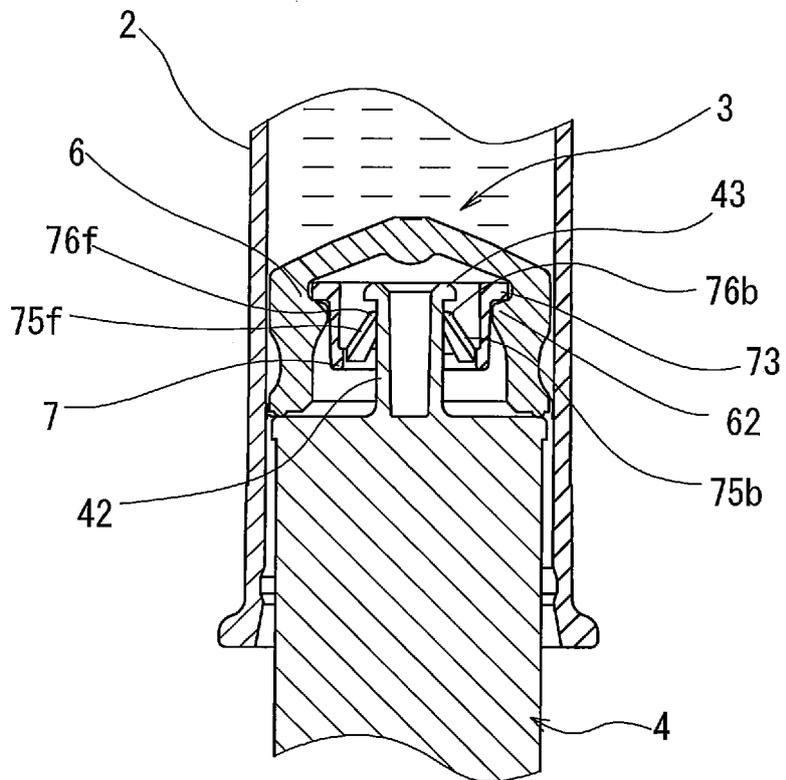


Fig.17

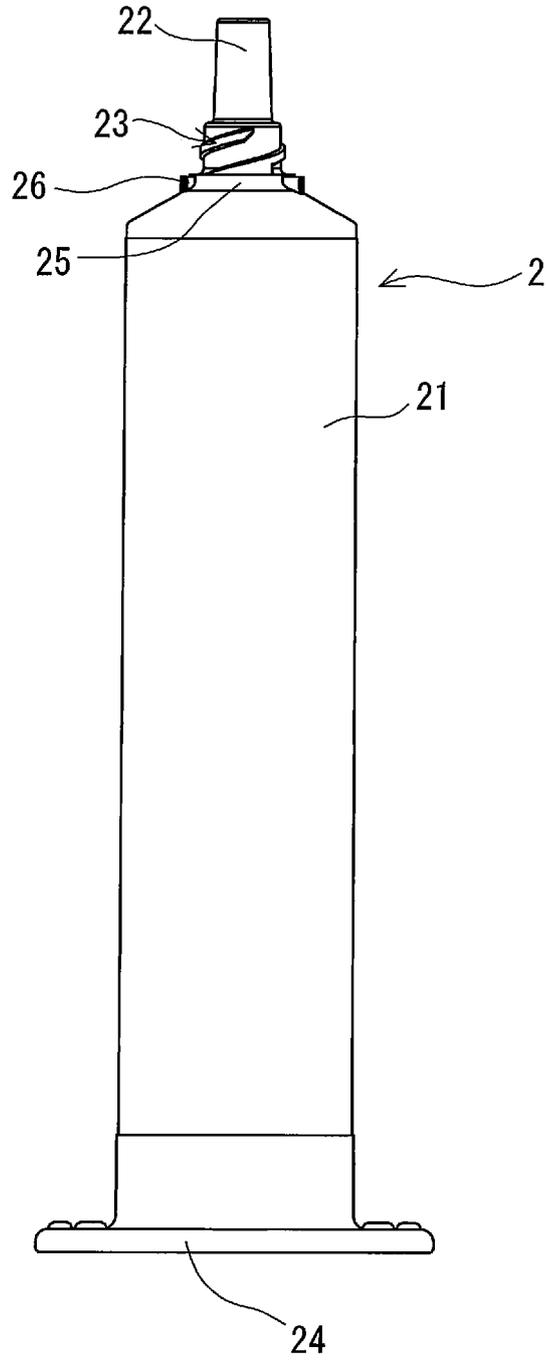


Fig.18

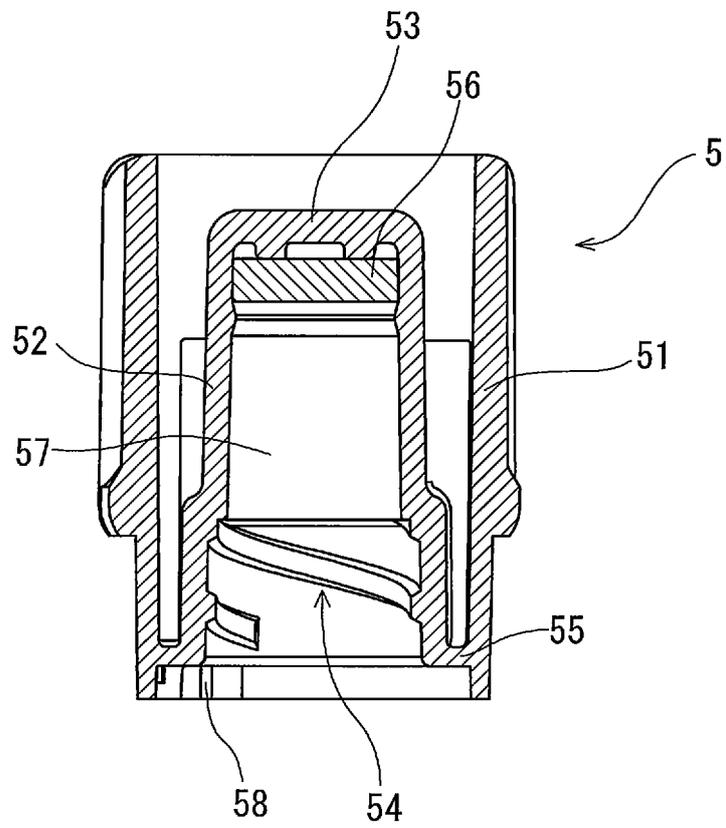


Fig.19

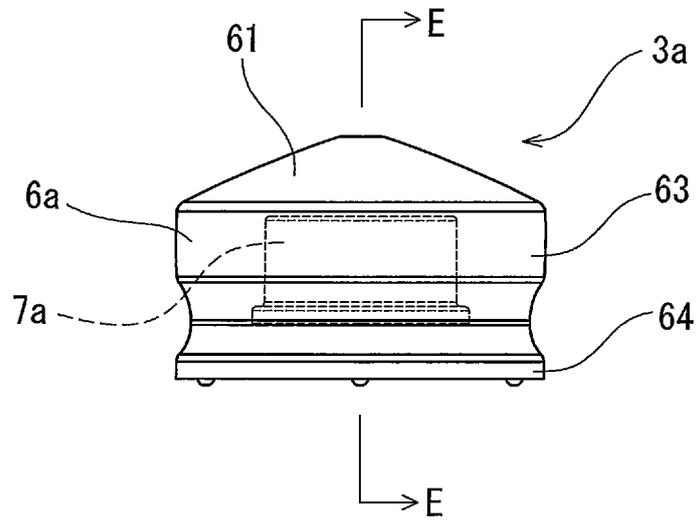


Fig.20

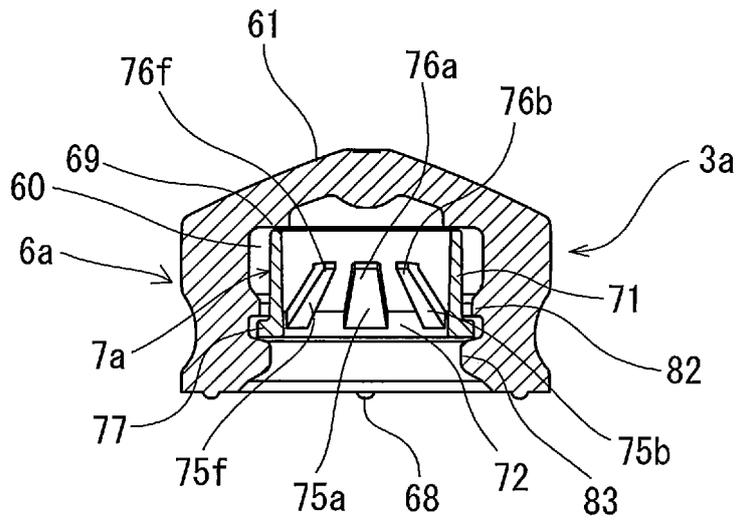


Fig.21

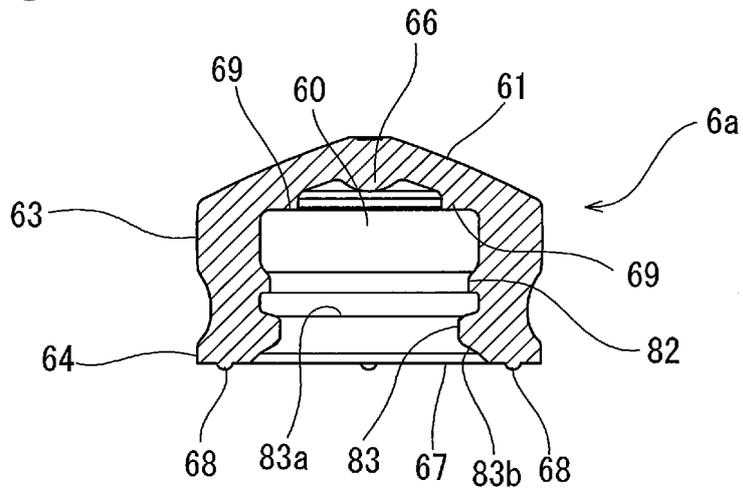


Fig.22

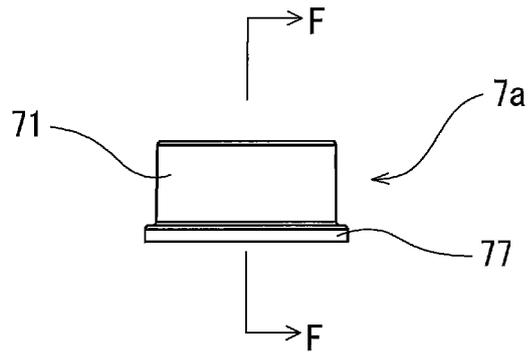


Fig.23

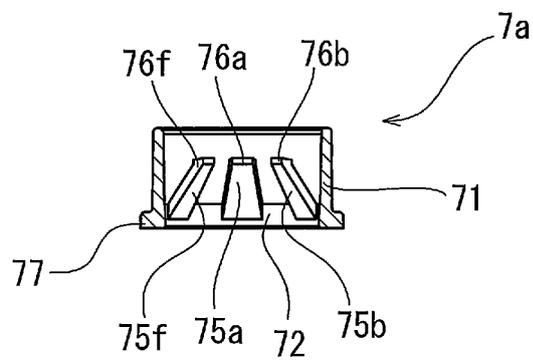


Fig.24

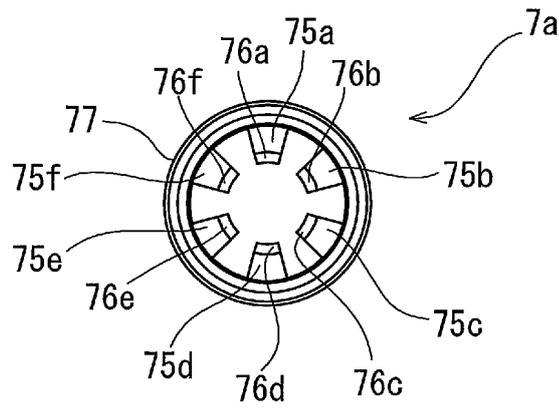


Fig.25

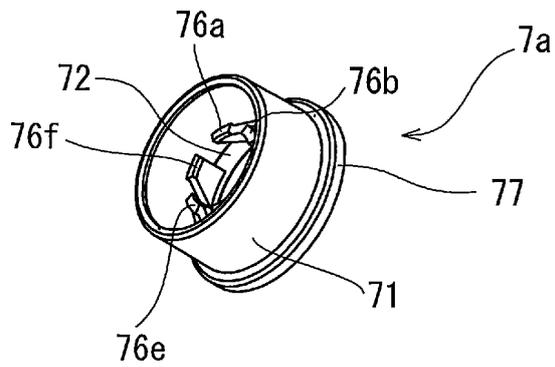


Fig.26

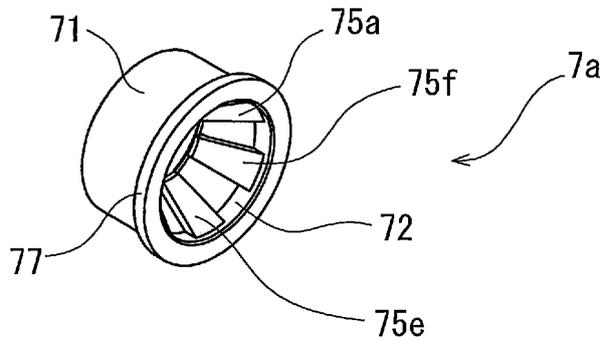


Fig.27

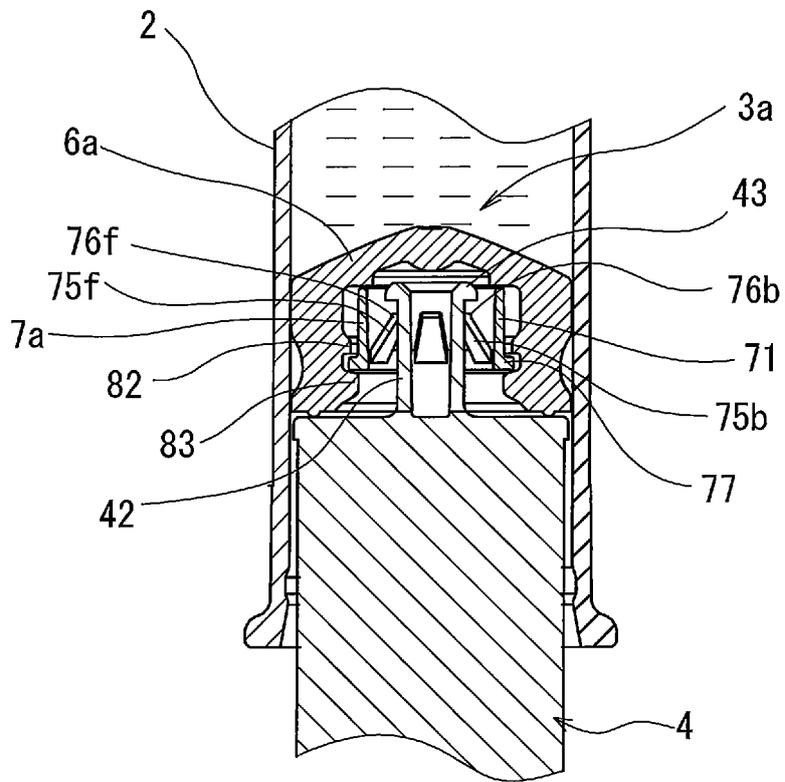


Fig.28

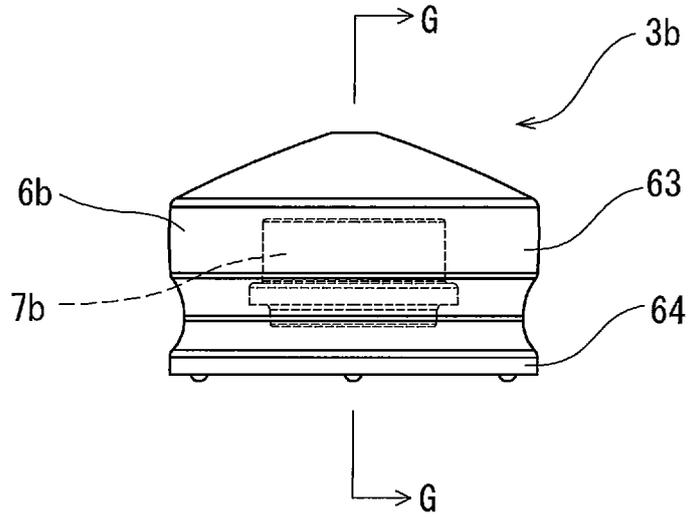


Fig.29

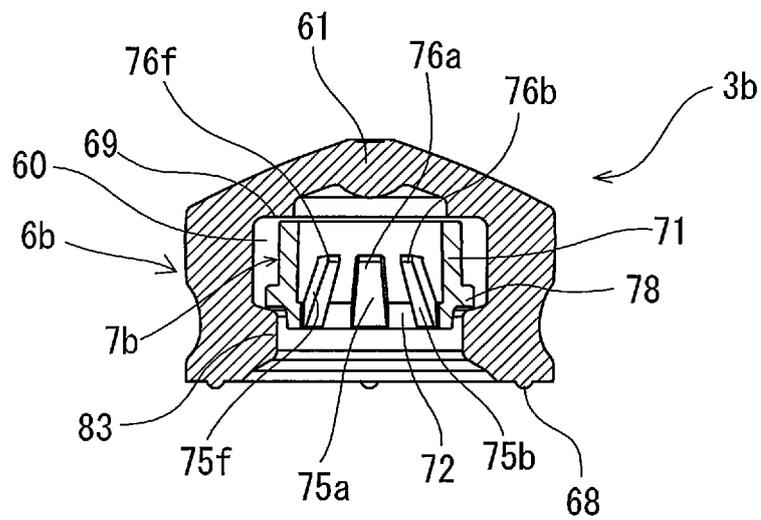


Fig.30

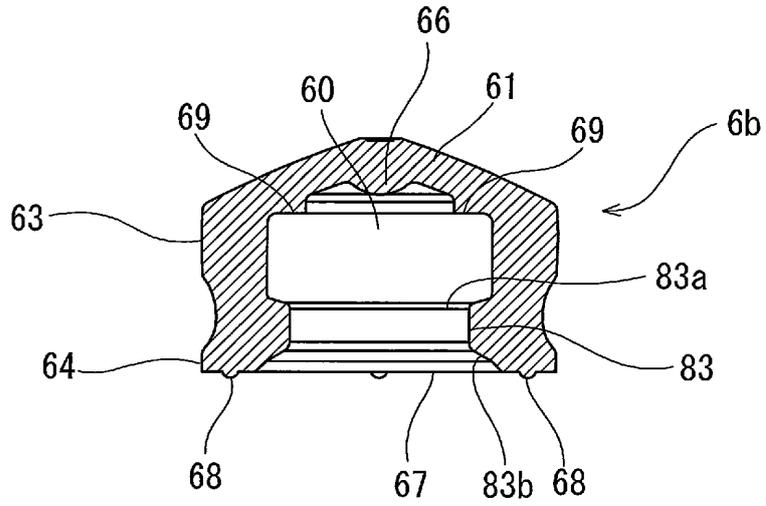


Fig.31

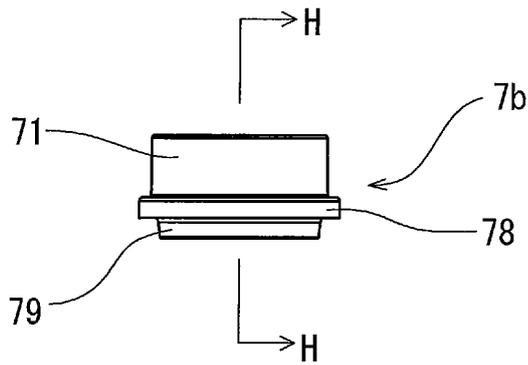


Fig.32

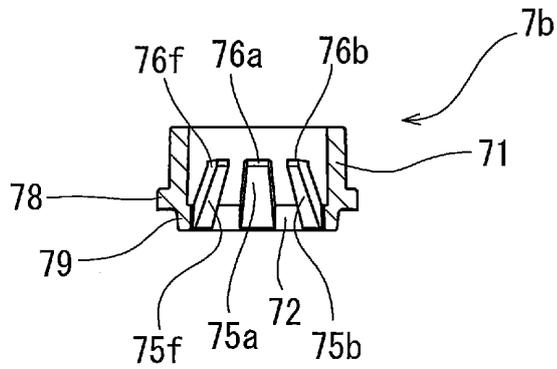


Fig.33

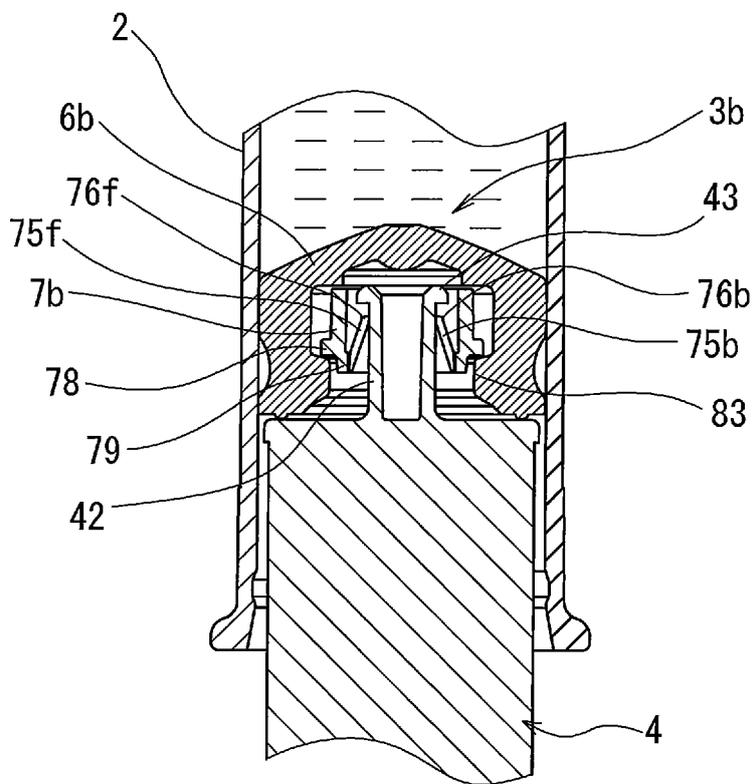


Fig.34

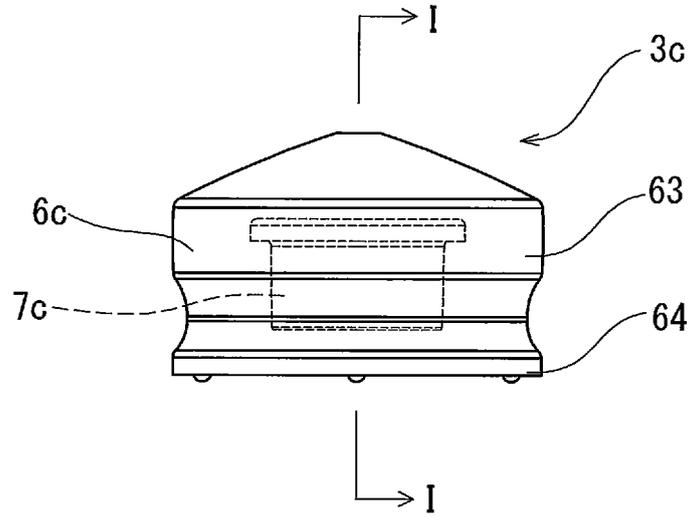


Fig.35

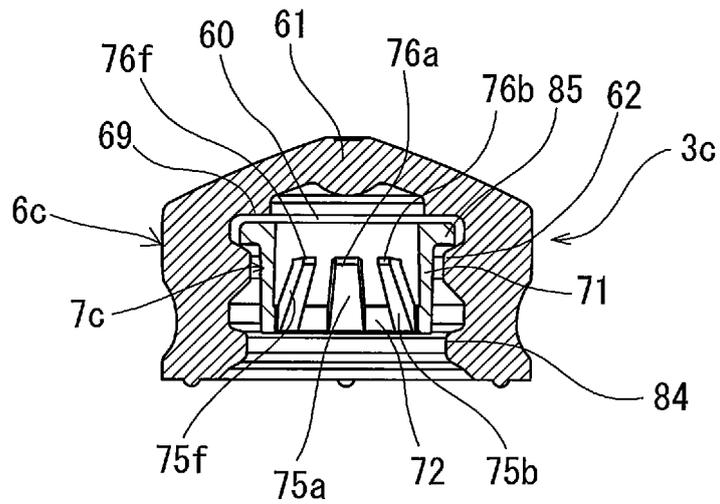


Fig.39

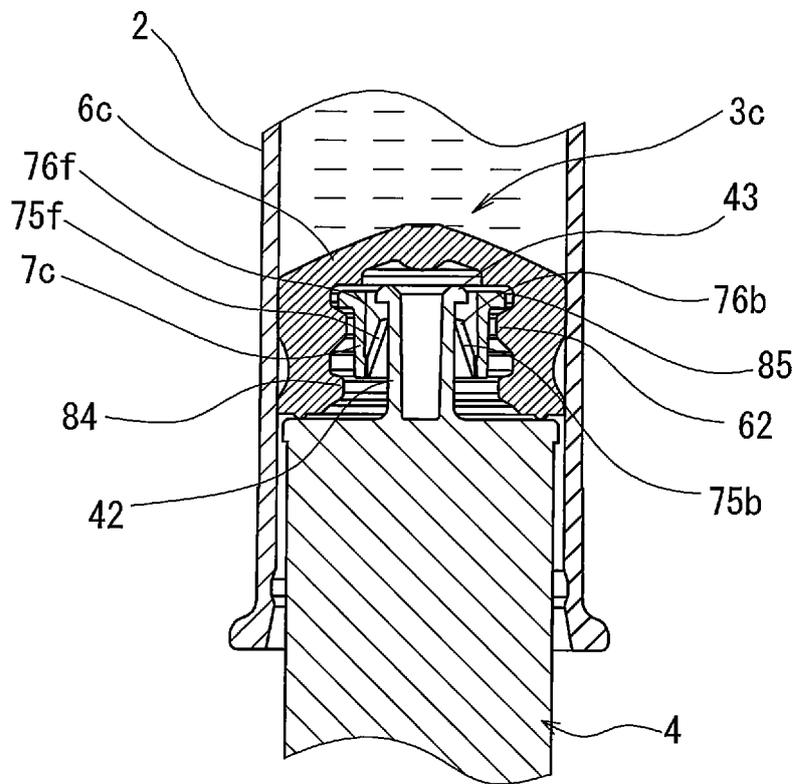


Fig.40

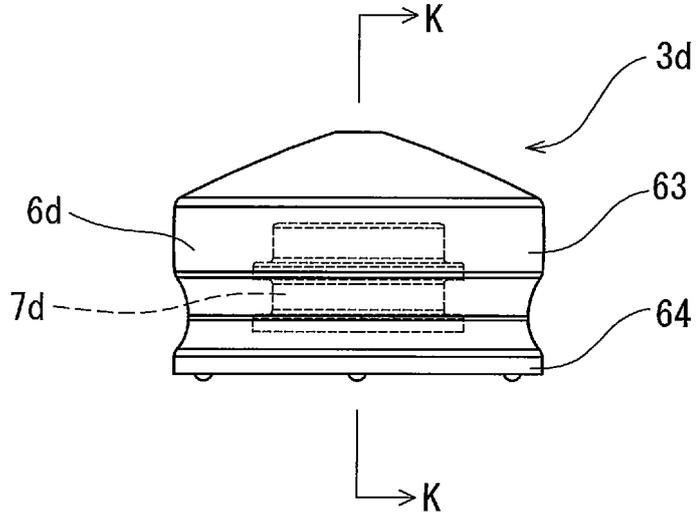


Fig.41

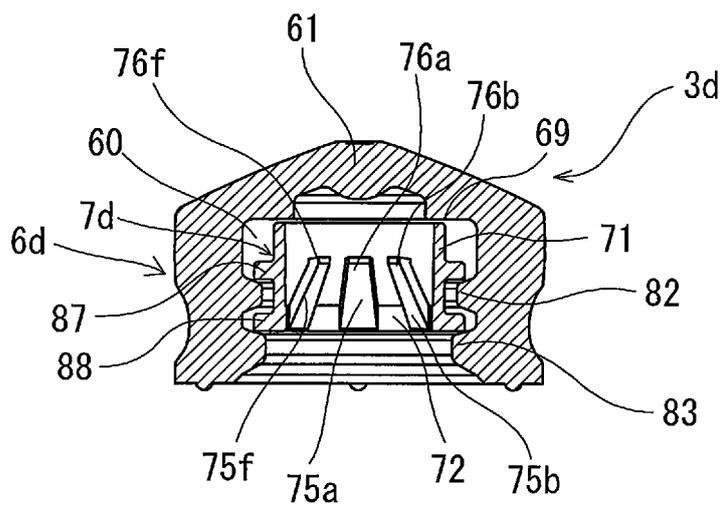


Fig.42

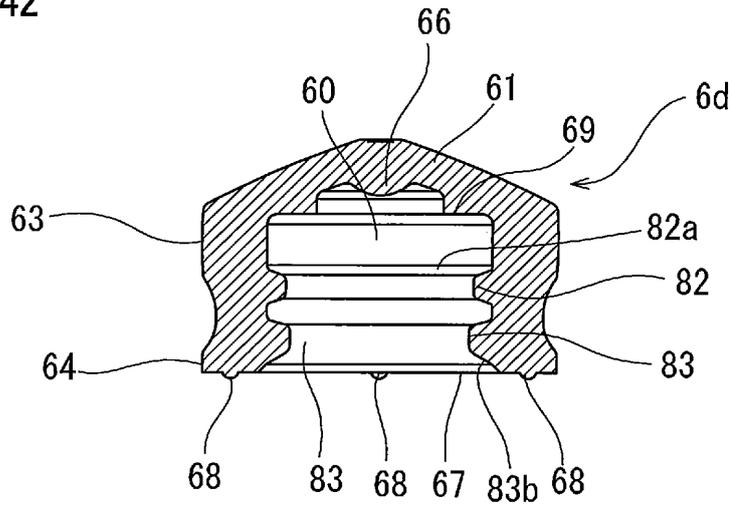


Fig.43

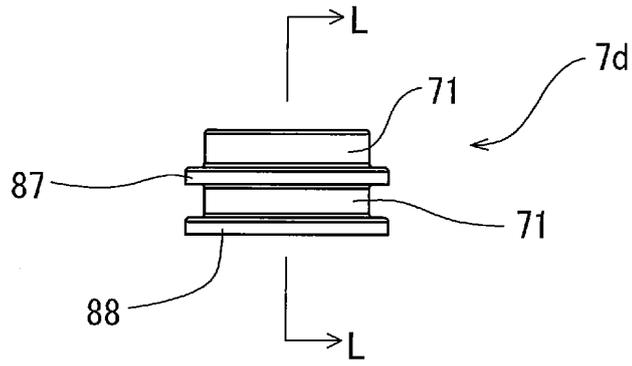


Fig.44

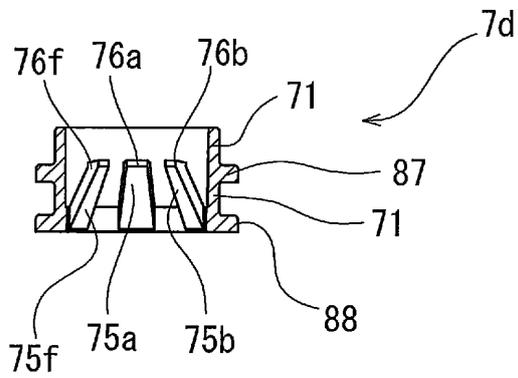


Fig.45

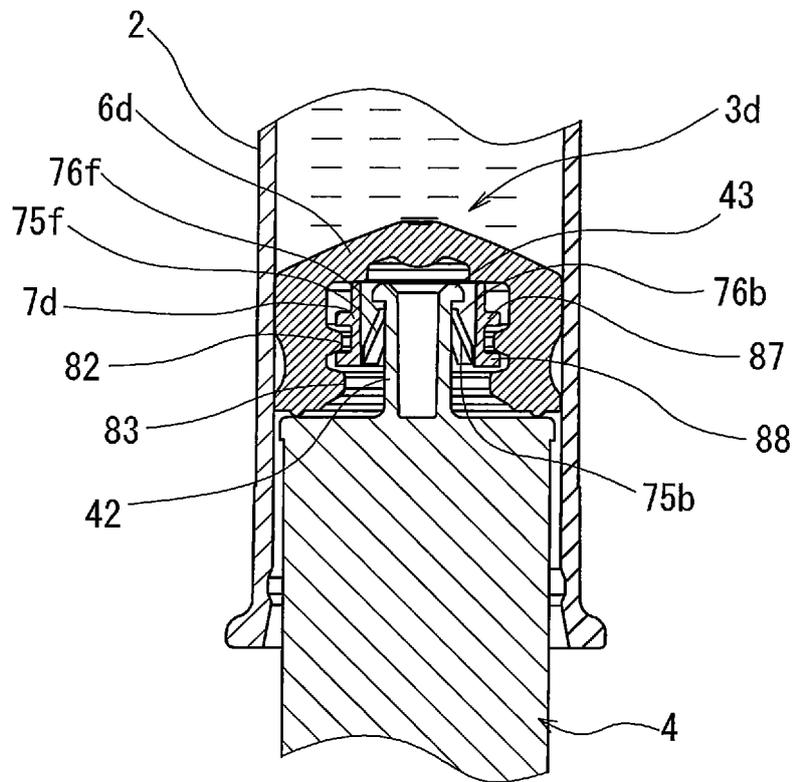


Fig.46

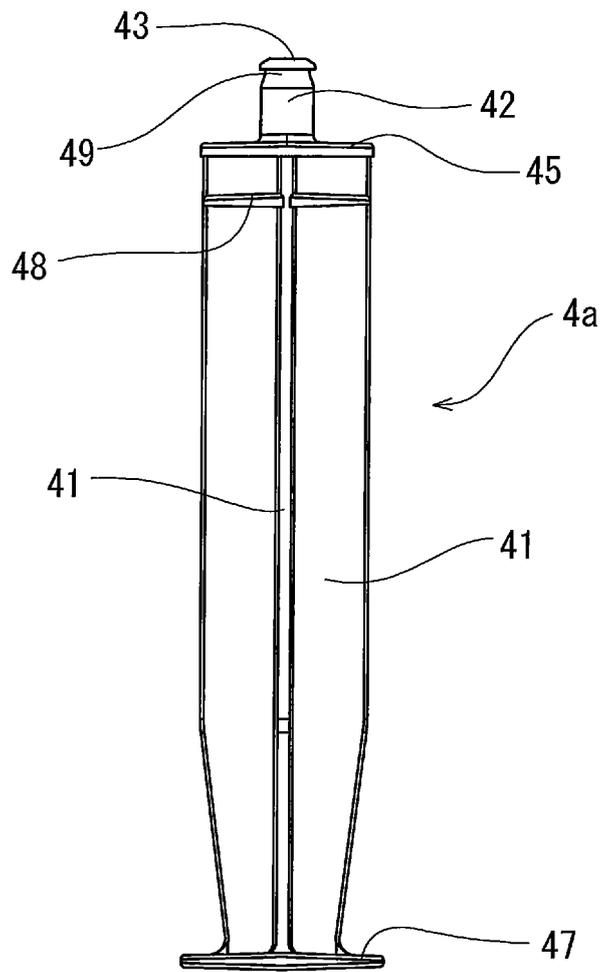


Fig.47

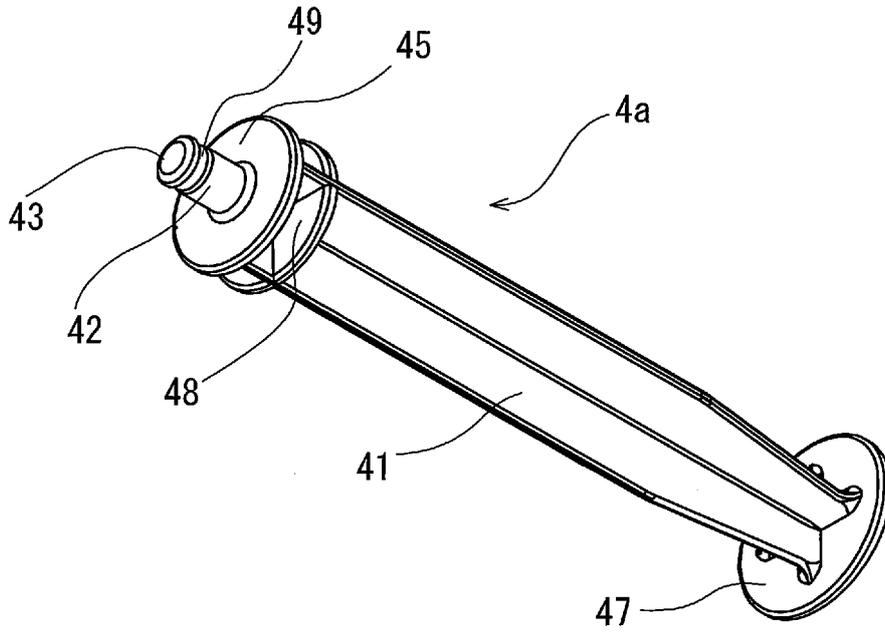


Fig.48

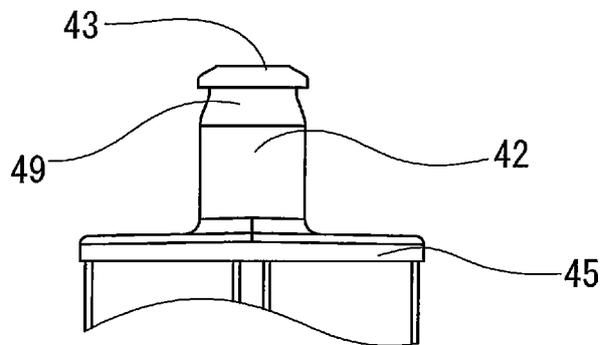


Fig.49

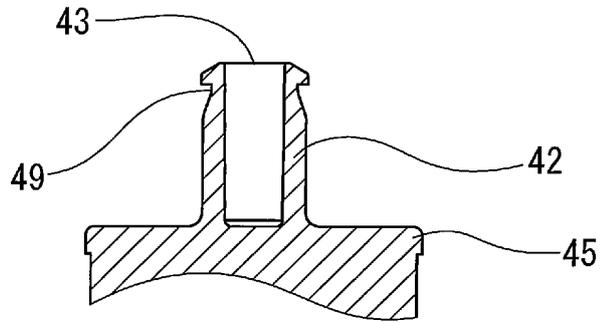
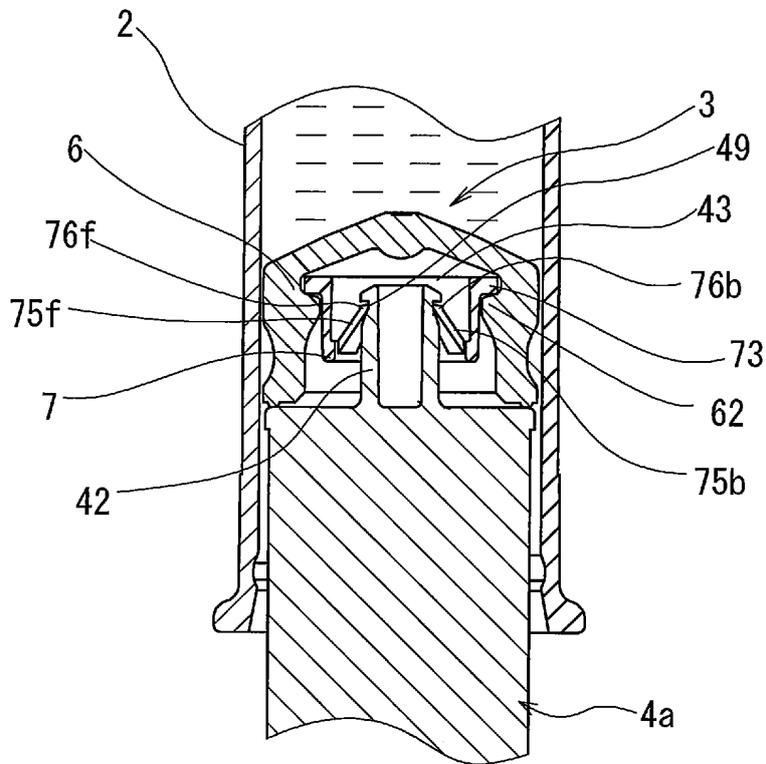


Fig.50



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2010/073733

| A. CLASSIFICATION OF SUBJECT MATTER A61M5/315 (2006.01) i | | |
|--|---|---|
| According to International Patent Classification (IPC) or to both national classification and IPC | | |
| B. FIELDS SEARCHED | | |
| Minimum documentation searched (classification system followed by classification symbols) A61M5/315 | | |
| Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2011 Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011 | | |
| Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) | | |
| C. DOCUMENTS CONSIDERED TO BE RELEVANT | | |
| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
| A | JP 2004-283466 A (Terumo Corp.), 14 October 2004 (14.10.2004), entire text; all drawings (Family: none) | 1-10 |
| A | CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 80917/1992 (Laid-open No. 39005/1994) (Arte Corp.), 24 May 1994 (24.05.1994), entire text; all drawings (Family: none) | 1-10 |
| <input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex. | | |
| * Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family | | |
| Date of the actual completion of the international search 17 January, 2011 (17.01.11) | | Date of mailing of the international search report 25 January, 2011 (25.01.11) |
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